Nourse

WASHINGTON OBSER FOR 1871.—APPENDIX IV.

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OF THE

FOUNDING AND PROGRESS

OF THE

UNITED STATES NAVAL OBSERVATORY.

"FOUNDED A. D. 1842.
JOHN TYLER,
PRESIDENT OF THE U. S.
ABEL P. UPSHUR,
SECRETARY OF THE NAVY."
Inscription on the tablet over the door of the Observatory.

PREPARED AT THE U. S. NAVAL OBSERVATORY

BY

Professor J. E. NOURSE, U. S. N.,

BY ORDER OF

REAR-ADMIRAL B. F. SANDS, U. S. N.,

SUPERINTENDENT U. S. NAVAL OBSERVATORY.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1873.

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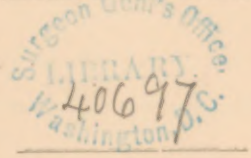

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1873.

UNITED STATES NAVAL OBSERVATORY,
Washington, December 20, 1872.

SIR: In accordance with your instructions that I should collate the facts bearing upon the founding and progress of the Observatory, I respectfully present the accompanying memoir as the result of a careful examination of official records, and of inquiry among those who have known the history of the Institution. My experience of the loss of time incurred in searching official documents has prompted me to cite volume and page of authorities for the benefit of those who may desire to look into the full records cited. In this connection it would be wrong for me not to acknowledge gratefully the very courteous assistance of Mr. G. S. Wagner, Librarian of the Senate, as well as that of the Librarian of Congress and his assistants.

Though fully conscious of the extreme disproportion between the work of the Observatory and this record of it, I trust that some useful purposes will be served by the memoir. The eminent names connected with the founding and location of the Institution—among which, besides those of the successive heads of the Navy Department, are those also of three Presidents of the United States—will elicit and secure attention; no less will the learned and eloquent advocacy of the Institution by one of these in the House of Representatives after his presidency.

The facts presented may seem to show a singular history as regards the earlier dates of the Observatory; but they will show just grounds for appreciating its labors, especially those of the years since the resumption of its full astronomical work in 1861.

It would have been pleasant to give the full lists of all who have been attached to the Institution; but as the design of the memoir was to deal with its *work*, space has not been found for its *personnel* at different dates; nor for much of tribute to its successful laborers. The official eulogies even of those who have fallen at their posts are omitted, their work being their memorial.

I am, sir, very respectfully, your obedient servant,

J. E. NOURSE,
Professor U. S. Navy.

Rear-Admiral B. F. SANDS, U. S. N.,
Superintendent U. S. Naval Observatory, Washington, D. C.

ERRATA.

Page 33, line 1; "2222," "2224," should read 2422, 2424.

Page 35, foot-note 3, "other" volumes should read *later* volumes.

Page 36, line 3, the name of Professor Lawrence belongs to a later date.

Page 38, line 2, "1852" should read 1853.

Page 39, the heading on this page was designed to read, for a NEW MERIDIAN INSTRUMENT.

Page 40, 7th line from foot of the page, "Observations" should read *Expedition*. The first comma in the next line should follow the word "Superintendent."

Page 44, 9th line from the foot of the page, "Alaska" should read *Behring Straits*.

MEMOIR OF THE FOUNDING AND PROGRESS OF THE UNITED STATES NAVAL OBSERVATORY.

First Memorial and Proposals in Congress for a National Observatory.

Congressional action for instituting a National Observatory originated in the earliest movement for establishing a first meridian in the United States. Of this movement, the following memoranda are compiled from the records of Congress:

Report by Hon. Mr. Pitkin, House of Representatives, 1810.

In the House of Representatives, March 28, 1810, Mr. Pitkin, of Connecticut, chairman of a select committee on a memorial from Mr. William Lambert, of Virginia, reported:[1]

"That the memorialist, 'for the purpose of laying a foundation for the establishment of a first meridian for the United States, by which a further dependence on Great Britain or any other foreign nation for such meridian may be entirely removed, has made calculations to determine the longitude of the Capitol at the seat of Government from Greenwich Observatory, England, and that there is urgent necessity for establishing such a first meridian at Washington, from the confusion already existing in consequence of the assumption of different places within the United States as first meridians, on the published maps and charts in our country." The committee urge the establishment of a first meridian still more from a national point of view. They present Mr. Lambert's calculations founded on an occultation by the moon of η Pleiadum, Alcyone, observed near the President's House on the night of October 20, 1804,[2] from which he deduces the approximate longitude of the Capitol to be $76^\circ\ 53'\ 6''.920$ west from Greenwich. Complimenting Mr. Lambert's astronomical ability, the committee recommend the authorizing of further observations by different methods, to determine a question of so much nicety and value. They report the following resolution:

"'That it is expedient to make provision by law authorizing the President of the United States to cause the longitude of the city of Washington from the Observatory at Greenwich to be ascertained with the greatest degree of accuracy, and, for that purpose, to procure the necessary astronomical instruments.'"

This report was laid upon the table, but on the 23d of January, 1811,[3] was referred to a second select committee, of which Josiah Quincy, of Massachusetts, and Dr. S. L. Mitchell, of New York, were members. This committee appears, however, to have been discharged at their own request, in order that the memorial might be referred to the Secretary of State.

[1] Eleventh Congress, second session, House of Representatives, Report No. 277: American Miscellaneous State Papers, volume II, page 53; March 28, 1810.

[2] See notes of this observation in Astronomische Nachrichten, volume vi, p. 388, and vol. xviii, p. 76 *et al.*

[3] Journal of House of Representatives, January 23 and February 23, 1811.

July 3, 1812, the Hon. Secretary of State, Mr. Monroe, replied through the Speaker of the House :[1]

"The principal object of the submission of the papers to the Department of State seems to have been to obtain from it a report on the policy, in a national point of view, of establishing a first meridian in the United States at the seat of Government. * * * The Secretary of State has no hesitation to declare his accord with the committee in their opinion in favor of the establishment of a first meridian for the United States, and that it should be at the city of Washington, the seat of their Government. Scientific men agree that it would be of advantage to science if all nations would adopt the same first meridian. * * * After the discovery of America, which banished the idea of a most western limit, that of a general meridian lost ground, and latterly it has been completely abandoned. * * * Since the period alluded to, the establishment of a first meridian for themselves has become, by the usage of nations, an appendage, if not an attribute, of sovereignty.

"The establishment of a meridian by the United States is deserving their attention, until, at least, by common consent some particular meridian should be made a standard. In admitting the propriety of establishing a first meridian within the United States, it follows that it ought to be done with the greatest mathematical precision. It is known that the best mode yet discovered for establishing the meridian of a place is by observations of the heavenly bodies; and, that to produce the greatest accuracy in the result, such observations should be often repeated, at suitable opportunities, through a series of years, by means of the best instruments. For this purpose an Observatory would be of essential utility. It is only in such an Institution, to be founded by the public, that all the necessary implements are likely to be collected together; that systematic observations can be made for any great length of time; and that the public can be made secure of the results of the labors of scientific men. In favor of such an Institution, it is sufficient to remark that every nation which has established a first meridian has also established an Observatory."

Mr. Monroe's report was referred to a second select committee, including, from the new Congress, Mr. Calhoun, of South Carolina. On the 20th of January, 1813, Dr. S. L. Mitchell, reported:[2]

"That they had diligently weighed Mr. Lambert's memorial, and the letter of the Hon. Secretary of State; that, in their opinion, astronomical observatories are highly useful to a navigating and commercial people, already eminent for their progress in science and the arts, and who are laboring for the completion of their national dignity and splendor; and that the most ready way of obtaining the information they desired, from noting the phenomena of the heavens, is by the establishment of an Observatory. This may be erected at the city of Washington. By such an Institution, means may be adopted, not only to fix the first meridian, but to ascertain a great number of other astronomical facts and occurrences through the vigilance of a complete astronomer."

[1] Journal of the House of Representatives, Twelfth Congress, volume 8, page 415; and American Miscellaneous State Papers, volume II, page 194.

[2] Report of the committee of the House of Representatives, and bill for a National Observatory, January 20, 1813: American Miscellaneous State papers, volume II, page 197, and Journal of the House of Representatives, 1813.

The bill accompanying this report was probably destroyed in the burning of the records of the Capitol in 1814. The report was read a second time and committed to a Committee of the Whole House for the 22d of the same month. Nothing, however, was again heard of it until the year 1815. The condition of the country and its military affairs probably absorbed the chief attention of the House, both in its open and its closed sessions.

In 1815, February 2d, Mr. Lambert's original memorial was again referred, with the several reports made and the letter of the Secretary of State, to a select committee, who reported through Mr. Nelson, of Virginia, on the 18th:[1] That the reasons detailed in the said reports appearing to be well founded, the committee had no hesitation in declaring their full assent to them. It was, also, the opinion of the committee that the plan proposed by the memorialist ought to be carried into complete effect, whenever attention to objects of a pressing nature and more immediate importance to the welfare of our country would permit, by the erection of a National Observatory, and by providing suitable instruments and apparatus, at the public expense, to enable skillful persons to determine the places of the moon, planets, and other heavenly bodies, with sufficient accuracy, by repeated and careful observations of the times of their transit over the meridian of the place. The report further recommended that the President of the United States be requested to cause such further observations to be made by competent persons as may be deemed most proper to determine the longitude of the Capitol with the greatest practicable degree of exactness, and that the results and data be laid before Congress at its next session. The Executive took no steps under this resolution, on the ground that it was not a joint resolution, but agreed to "by the House of Representatives *alone*."[2]

In November, 1818, a third memorial was presented by Mr. Nelson from Mr. Lambert, claiming "that the abstracts of astronomical calculations, to ascertain the longitude of the Capitol, for the establishment of a first meridian, according to the original plan of the city, are founded on the most accurate data that could be had at the respective times when the observations were made, and have been admitted by the American Philosophical Society of Philadelphia, into the last volume of their Transactions;"[3] that the memorialist does not ask that "an Observatory be erected and furnished with suitable instruments at the present time; but solicits the adoption of a concurrent resolution authorizing additional observations to test the accuracy of the results already obtained by such methods as may be best adapted to insure a correct determination of our longitude from Greenwich."

The memorial was referred to a select committee,[4] Mr. Nelson, chairman, who reported the joint resolution asked for, which, however, was not finally passed until March 3, 1821. Mr. Lambert was then appointed by the President, "to make astronomical observations by lunar occultations of fixed stars, solar eclipses, or any approved method adapted to ascertain the longitude of the Capitol from Greenwich."[5]

[1] Report and bill for a National Observatory, No. 386, American State papers, Thirteenth Congress, third session and House Journal for 1815.

[2] Miscellaneous American State Papers, volume II, page 759.

[3] Philosophical Transactions, new series, volume I, page 102.

[4] Journals of the House of Representatives, 1819, 1820, 1821.

[5] American Miscellaneous State Papers, volume II, page 769.

In his report, submitted to Congress by President Monroe, January 8, 1822, Mr. Lambert refers to the loan of instruments for his work by one of the Departments, which instruments had been brought from Europe for the special purpose of surveying our sea-coasts, among which instruments were a transit-instrument, a circle of reflection, an astronomical clock, and a chronometer: and to his testing the accuracy of the time-pieces by a series of observations before any calculations were made. He submits extended abstracts of a series of observations of the moon's transit over the meridian, and of the eclipse of the sun, August 26, astronomical (27, civil) reckoning.[1] He gives, as the mean results by the different methods employed

Longitude of the Capitol, west from Greenwich,	76° 55′ 30″.54
Longitude of the Capitol, west from Paris, - - - - -	79° 15′ 41″.69
Longitude of the President's House, west from Greenwich,	76° 57′ 5″.33

His report, which occupies more than twenty pages folio of the printed State Papers, closes with this statement:

"The legislative and executive authorities of the National Government will decide on the utility or inexpediency of erecting an Observatory and furnishing it with suitable instruments and apparatus. Without such an Institution, the right ascension, declination, longitude, and latitude of the moon, planets, &c., cannot be ascertained with sufficient accuracy; and any attempt to compute a nautical almanac or astronomical ephemeris for ourselves would be futile, if not preposterous. Until an Observatory be erected and furnished, we shall be compelled to rely upon the labors of scientific men for the elements necessary to be used in our astronomical calculations."[2] * * * *

A "supplementary Report" from Mr. Lambert, March 7, 1822, gives the longitude of the Capitol 76° 55′ 10″.05 west.

The President communicated, December 23, 1823, a second supplementary report[3] —occupying 140 closely printed pages of the Executive Documents—in which the memorialist states that he had transmitted copies of his calculations to various sections of the United States and of foreign countries, to induce an impartial investigation by competent persons of the accuracy of his work, and closes with the strongest re-affirmations of all previously submitted, in favor of establishing an Observatory. This report gave the longitude of the Capitol, 76° 55′ 30″.54.[4]

It was committed to the Joint Committee of the Library; and a report upon it was made by Hon. Mr. Smyth, February 25, 1824, but laid upon the table. No further trace of it can be found, since the files of the Joint Committee previous to 1851 were all destroyed by the fire in the Congressional Library in December of that year.

[1] In order to be prepared for correct transit observations, a meridional line was drawn by means of concentric circles on a large platform, nineteen feet west of the original line, marked by Mr. Andrew Ellicott, astronomer under the commissioners for laying out the seat of Government, and its direction from one of the windows at the south wing was verified with minute exactness.

[2] Message of the President of the United States, December 23, 1823, Journal of the House of Representatives, Eighteenth Congress, first session.

[3] Journal of the House of Representatives, February 25, 1824.

[4] Mr. William Elliot, appointed by Mr. Lambert to make the transit observations, reports the longitude of the Capitol, 77° 1′ 48″ west.

A National Observatory recommended by President Adams, December 6, 1825.

In the first message of President Adams, he urged on Congress the establishment of a National University, in language which appears evidently to look for the location of the Institution on the grounds now belonging to the Observatory:[1]

"Among the first, perhaps the very first, instruments for the improvement of the condition of men is knowledge; and to the acquisition of much of the knowledge adapted to the wants, the comforts, and enjoyments of human life, public institutions and seminaries of learning are essential. So convinced of this was the first of my predecessors in this office, now first in the memory, as living he was first in the hearts, of our country, that once and again, in his addresses to the Congresses with whom he co-operated in the public service,[2] he earnestly recommended the establishment of seminaries of learning, to prepare for all the emergencies of peace and war, a National University and a Military Academy. With respect to the latter, had he lived to the present day, in turning his eyes to the Institution at West Point, he would have enjoyed the gratification of his most earnest wishes. But in surveying the city which has been honored with his name, he would have seen the spot of earth which he had destined and bequeathed to the use and benefit of his country as the site for a University, still barren and bare."

In a later part of the same message, Mr. Adams returns to the theme, then becoming his favorite, and which, at a later day, he elaborately advocated—in 1838, before President Van Buren, and in 1842, in his place in the House of Representatives:

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[1] President's message, first session, Nineteenth Congress.

[2] Washington's speeches to Congress in New York, January 8, 1790, and in Philadelphia in December 8, 1796:

* * "Knowledge is in every country the surest basis of public happiness. * * To the security of a free Constitution it contributes by teaching the people themselves to know and value their own rights, * * to discriminate the spirit of liberty from that of licentiousness, cherishing the first, avoiding the last, and uniting a speedy but temperate vigilance against encroachments, with an inviolable respect for the laws. Whether this desirable object will be best promoted by the institution of a National University, or by any other expedients, will be well worthy of a place in the deliberations of the Legislature."

"I have heretofore proposed to Congress the consideration of the expediency of establishing a National University. * * * The assembly to which I address myself is too enlightened not to be fully sensible how much a flourishing state of the arts and sciences contributes to national prosperity. * * Amongst the motives to such an institution, the assimilation of the principles, opinions, and manners of our countrymen by the common education of a portion of our youth from every quarter, well deserves attention. The more homogeneous our citizens can be made in these particulars, the greater will be our prospect of permanent union."

To the *first* of these communications the Senate replied in their answer to the Address:

* * "Literature and science are essential to the preservation of a free constitution; the measures of government should, therefore, be calculated to strengthen the confidence due to this important truth."

To the *second* recommendation by Washington, in 1796, the Senate replied:

"A National University may be converted to the most useful of purposes; the science of legislation being so essentially dependent on the endowments of the mind, the public interests must receive effectual aid from the general diffusion of knowledge."

The recommendations were discussed, advocated by Madison and others, and their consideration postponed, April 27, 1796.

The WILL of General Washington bears witness to his retaining, to the close of life, these same ideas of the benefits of a national scientific Institution. After expressing his life-long regrets that the youth of the United States should be sent abroad for the purpose of education, he says, "It has been my ardent desire to see a plan devised, on a liberal scale, which would have a tendency to spread systematic ideas throughout all parts of this rising empire, hereby to do away with local attachments and State prejudices. * * * My mind has not been able to contemplate any plan more likely to effect the measure than the establishment of a university, where the youth of our country may be able to free themselves from local prejudices and jealousies pregnant of mischievous consequences to our country."

"Connected with the establishment of a University,[1] or separate from it, might be undertaken the erection of an astronomical Observatory, with provision for the support of an astronomer, to be in constant attendance on the phenomena of the heavens, and for the periodical publications of his observations. It is with no feeling of pride as an American, that the remark may be made, that, on the comparatively small territorial surface of Europe, there are existing more than one hundred and thirty of these light-houses of the skies; while throughout the whole American hemisphere there is not one. If we reflect a moment upon the discoveries which in the last four centuries have been made in the physical constitution of the universe by means of these buildings and of observers stationed in them, shall we doubt of their usefulness to every nation? And while scarcely a year passes over our heads without bringing some new astronomical discovery to light, which we must fain receive at second hand from Europe, are we not cutting ourselves off from the means of returning light for light, while we have neither observatory nor observer upon our half of the globe, and the earth revolves in perpetual darkness to our unsearching eyes?"

This part of the message was referred to a select committee, of which Mr. C. F. Mercer, chairman, presented, March 18, 1826, an elaborate report from Major-General A. Macomb, Chief of Engineers, as the report of the committee.[2] The report was accompanied by "A bill to establish an Observatory in the District of Columbia." The following are a few extracts from General Macomb's report:

"ENGINEER DEPARTMENT,
"*Washington, March* 6, 1826.

"Hon. JAMES BARBOUR, *Secretary of War:*

"SIR: In obedience to your direction, I have considered the inquiries concerning the establishment of an Observatory, presented in the communication addressed to you on the 30th of January, by the Hon. C. F. Mercer, as chairman of the committee to whom was referred so much of the President's message, to the present Congress, as relates to that subject: 1st, in relation to the position; 2d, the probable cost of a suitable edifice; 3d, the expense of providing it with the necessary attendants, furniture, and instruments. * * * * With reference to these inquiries, I have the honor to state as follows:

"1st. With regard to the position. The city of Washington offers many excellent positions, especially one on the reservation of the public square which lies between Mason's Island and the mouth of the Tiber, where the land is sufficiently elevated and where a sufficient line can be found to establish a meridian, taking one point north on the prolongation of a street over Rock Creek, and the other across the Potomac, on the lands of Mr. Custis, of Arlington.[3] * * *

[1] Mr. Adams, in a report of a later date,* expressed his uncertainty whether Congress possesses, under the Constitution, the power to establish a National University. He seems to have had in mind that the proposition of Madison and Pinckney, to insert in the list of powers vested in Congress a power to establish a university, had failed in the Convention of 1787; chiefly, however, because Gouverneur Morris, in the Convention, urged that the provision was "unnecessary; saying "the exclusive power at the seat of Government will reach that object."†

[2] First session Nineteenth Congress, House of Representatives, report No. 124, March 18, 1826.

[3] In the introduction to the annual volumes issued by the Naval Observatory, for the years 1846, 1847, and 1848, the Superintendent states the difficulties in effecting this—which has not indeed been found necessary.

*Report No. 581, Twenty-seventh Congress second session, page 28.

†Madison Papers, volume III, page 1577.

"The astronomer ought to be independent in the performance of his duties, but accountable for the results, for his industry, and the correctness of his observations and calculations. The results of his scientific labors should be given to the world, in order that they might be duly examined by astronomers of different countries, whose attention would naturally be attracted to works of this character, emanating from the metropolis of the United States. Foreign as well as domestic criticism would thus stimulate the astronomer to great vigilance and attention. It would be proper, therefore, that an annual report should be made to Congress, exhibiting the observations taken at the Observatory; and, as soon as circumstances would permit, a nautical almanac, or astronomical ephemeris, should be prepared and published for the use of the Navy and commercial marine. To save the astronomer all trouble in obtaining supplies of various kinds which would be required on account of the Observatory, in making expenditures, receiving communications, and with reference to other details connected with it; and, in order that communications and reports might be made to Congress in a regular manner, it would be proper that he should be made responsible to, and correspond and communicate with, some established department of the Government. * * * As an astronomer, with the requisite talents and qualifications, would be obliged to devote all his time and attention to the duties of his station, it is not to be expected that a fit person could be procured for this situation without the compensation of a liberal salary." * * *

In a communication submitted also by General Macomb with this letter to the Hon. Secretary of War, M. de Wallenstein, then an attaché of the Russian legation, thus speaks of the proposed location of the Observatory:

* * * * "Allow me to mention one of the important advantages which may be expected from an Observatory in this metropolis. The liberality with which the British government has provided for the creation of such an establishment on the Cape of Good Hope has been so much the more celebrated by the scientific world as this new observatory lies nearly under the same meridian as that of Abo. Astronomy must necessarily be benefited by it. Now, Washington lies more exactly on the same meridian with a great Capital for a southern hemisphere; with Lima, the difference of longitude being only thirty-five seconds in time, or 8′ 45″ in arc; and Peru which occupies a distinguished place in the history of astronomy, has, perhaps, already in its principal city, a regular Observatory."

Major Kearney's letter (accompanying also General Macomb's report) is chiefly occupied with the details of a plan for a building, referring to the form and the construction of the observatories at Greenwich, Wilna, Berlin, Petersburg, Dublin, and other places. It is followed by extracts from Francis Baily's Memoir on a new method of determining the longitude, in which a general account is given of the efforts then making for the promotion of astronomy.[1] In this memoir, Mr. Baily expresses an expectation that the American states recently constituted in the South will be as favorable to astronomy as the older state which first assumed its liberty in the North.

Mr. Mercer's report and bill were read the first and the second time, and com-

[1] Memoir of the Royal Astronomical Society, volume 2, page 25.

mitted to the Committee of the Whole House for the following Monday; but the House Journals show no further trace of them whatever.

The biographer of Mr. Adams thus speaks of this and of the other special recommendations of his first message, among which were those for a Naval School, and one for another national object, which had been long his profound study when abroad, viz, the establishing of a uniform standard of weights and measures[1]:—

"Every one of these recommendations, though obviously associated with the progress of the nation, and independent of all party or personal influences, was treated with neglect, or suffered to lie unnoticed, or to be lost by indefinite postponement."

It is as creditable to Mr. Adams as it is interesting to the Observatory that he did not relax his labors for its institution, but yet more vigorously renewed them at later dates, in 1836, 1838, 1840, and 1842.

Official action following Mr. Mercer's report.

An examination of the messages of the several Presidents immediately succeeding Mr. Adams, and of the accompanying documents, reveals no special action, on the part of the Executive or of Congress relative to an Observatory, until the year 1830. On the 18th of March, 1830, Hon. Mr. Branch, Secretary of the Navy, replied to a letter of inquiry from Hon. Mr. Hoffman, chairman of the Committee on Naval Affairs, House of Representatives:

"As far as I have been able to obtain information on the subject, an astronomical Observatory would be a desirable establishment in the United States for the following reasons:

"1st. In a national point of view, as it would furnish the means of making such observations as would enable astronomers to ascertain or calculate the positions of the heavenly bodies, at any time, without being dependent on other nations for the same; and would be, moreover, a fixed point to whose meridian (commonly called a first meridian when used for geographical purposes) terrestrial objects may, with certainty, be referred, as far as respects their longitudes.

"2d. It would, furthermore, be desirable in a scientific point of view, as it would present the means of comparing certain astronomical results, for the purpose of determining the figure of the earth, and improving theories relative to the motions of planetary bodies. * * * * It ought to have a certain and fixed location with respect to some other place, whose geographical position has been well established, as the observatories of Paris and Greenwich, &c. This, inasmuch as the ocean intervenes, (the measurement of which cannot be made with the precision necessary for such purposes,) must be effected by celestial observations, which, as is well known, can be made with greater accuracy and under greater advantages in an Observatory than elsewhere." * * * * *

In a letter of the same date to the Secretary of the Navy, from Commodore John Rodgers, president of the Board of Navy Commissioners, the Commissioners say:

"The principal object in establishing an Institution of this kind in the United States would not be to aid, essentially, the surveying of our coast, but to unite our enterprise and efforts with those of other enlightened countries; in advancing, generally, the service of

[1] American Miscellaneous State Papers, volume II, page 656. Report of J. Q. Adams, Secretary of State, on Weights and Measures, Sixteenth Congress, second session, No. 503, February 22, 1821.

astronomy, amending theories at present adopted of the heavenly phenomena, (all of which are still supposed to be susceptible of greater or less improvement,) and to furnish annually our naval and commercial interests with a correct ephemeris, upon the accuracy of which depend so much the safety of our commerce and the lives of our seamen."

In his report of December 5, 1835, Hon. Mr. Dickerson, Secretary of the Navy, says:

"A National Observatory, although not immediately necessary to the defense of our country, is remotely so; and, considered with reference to the bearing it would have upon our Navy, our commerce, and scientific pursuits, it assumes an importance worthy the consideration of Congress. It is hardly to be doubted that we shall, at some future period, make such an establishment, and I will venture to express an opinion that no time can be more propitious for such an undertaking than the present. It would not be attended with any great expense. It is necessary now to employ an officer of science to keep our maps and charts, to regulate our chronometers, and to preserve all mathematical and philosophical instruments required for the naval service; and buildings are necessary for these purposes. These duties would properly devolve upon the superintendent of an Observatory; and the buildings necessary to such an establishment would be amply sufficient for the preservation of our maps, charts, and instruments."

There is no record of an indorsement by the President of this proposition from the Secretary; nor can I find any further record of congressional action, leading directly to the establishment of an Observatory, until the years 1841–'42. The statement of the Secretary, in 1835, referring to the employment of an officer of science, to keep maps and charts, pointed to the previous action of the Navy Department, in establishing, in 1830, a bureau for the care of naval instruments and charts.

This action, under the Navy Commissioners, (authorized December 6, 1830,) is the first point of a distinct era in the history of this Institution. The brief record of it which follows will show that, after so many years of delay and apathy on the part of Congress as regards the establishment of an Observatory, it was left for a few officers of the Navy to originate and prosecute such measures as resulted in the creation of the present Institution. The record of their labors falling in at this place in point of time, will be now given, the congressional and executive action being next resumed. For the history of the events leading to the establishment of the depot, I cite largely from Lieutenant Gilliss's report of 1845.

Establishment of the Depot of Charts and Instruments.

"Through the influence of Lieutenant L. M. Goldsborough, (now Rear-Admiral, United States Navy,) a bureau was established in this city in 1830, for the care of the instruments, charts, &c., of the Navy."[1] Under the orders of the Navy Commissioners,[2] by the sanction of the Secretary of the Navy, Lieutenant Goldsborough had collected and brought, from New York and other places, the chronometers, sextants, theodolites, and other instruments and the charts of the Navy, and had located them in Washing-

[1] Report of Lieutenant J. M. Gilliss, February 7, 1845, Twenty-eighth Congress, second session, No. 114, Senate.

[2] Records of the Navy Commissioners, December 6, 1830. Files of the Navy Department.

ton, in a building opposite the residence of the United States Attorney-General, Hon. William Wirt. A transit-instrument, at the price of forty guineas, was afterward added.

The further interest manifested by the Navy Commissioners, in what was leading to an Observatory, appears in their letter to the Secretary,[1] on the subject of employing Messrs. Jenkins and Taylor to prepare an American nautical almanac. In this letter they say:

"As a matter of national pride and independence, it would be desirable to have an American nautical almanac adapted to a first meridian of our own. * * * * An almanac of this kind would be one of the first fruits of an Observatory, should Congress deem it expedient to establish one." For such an establishment, Commodore Charles Morris, one of the Commissioners, was a zealous advocate.

Lieutenant Gilliss further says:

"One of the duties of the officers connected with the Depot of Charts and Instruments was the careful rating of all chronometers belonging to the Navy, which was, for some months, effected by sextant and circle observations, but, between the summers of 1831 and 1833, with a thirty-inch transit-instrument, made in New York by Mr. R. Patten. The transit was mounted within a small circular building, upon a brick pier, having a base about twenty feet below the surface. To Lieutenant Goldsborough, therefore, is due the erection of the first astronomical instrument for the Navy at Washington.

"He was succeeded in the charge of the depot in 1833 by Lieutenant Wilkes, (now retired Rear-Admiral United States Navy,) who obtained permission from the Navy Commissioners, and removed the office from its location in the west end of Washington to Capitol Hill, to a site proposed originally by Mr. F. R. Hassler, in 1816, about 1,000 feet north, 5° west, from the dome of the Capitol, where it remained till July, 1842. Here Lieutenant Wilkes erected, at his own expense, an Observatory sixteen feet square, and mounted one of the five-foot transits, made by Troughton for the Coast Survey in 1815, which was loaned by Mr. Hassler for the purpose. It does not appear, however, that any regular series of observations was commenced until the departure of the Exploring Expedition in 1838; the principal use made of the transit being the determination of time.[2] This was a daily requisite, as the comparing-clock performed irregularly, and was not to be relied on more than twenty-four hours, nor was it possible to procure proper astronomical instruments exclusively for the depot.

"During the absence of Lieutenant Wilkes, in Europe, to purchase instruments for the Exploring Expedition, Lieutenant Hitchcock took charge of the depot, and Lieutenant Gilliss was ordered as his assistant, in November, 1836, and was left in charge in the following spring, on the appointment of Lieutenant Wilkes to the survey of George's Shoal. In the winter of 1837–'38, while Lieutenant Wilkes was surveying

[1] Letter of Commodore John Rodgers for Navy Commissioners, to the Hon. Secretary of the Navy, December 10, 1831. Files of the Navy Department.

[2] From this depot of Naval Instruments and Charts, however, all United States vessels, on going to sea, were furnished from the first, with chronometers and other instruments and charts, as subsequently they were thus furnished from the United States Naval Observatory, until the organization of the Hydrographic Office in 1866. Chronometers are still necessarily retained in charge of the Observatory for trial and rating.

the entrance to Savannah River, Lieutenant Gilliss observed, at his request, all the culminations of the moon and stars tabulated with it which occurred before midnight; but the observations were never reduced. When Lieutenant Wilkes accepted the command of the Exploring Expedition in 1838, the importance of corresponding moon culminations, occultations, and eclipses, in determining differences of longitude between this observatory and the stations which the Expedition might occupy abroad, was suggested to the Department, and Mr. William C. Bond, at Boston, and Lieutenant Gilliss, were directed to continue such observations during its absence. Both the astronomical and the magnetical and meteorological observations were to be made under the following order from the Hon. Secretary of the Navy:[1]

"NAVY DEPARTMENT, *August* 13, 1838.

"SIR: Mr. Bond, of Boston, has been employed to make a series of observations during the absence of the Exploring Expedition, and in connection with it. It is deemed proper that similar observations be made at the Depot of Charts and Instruments. You are, therefore, charged with the performance of this duty; and in conducting the same you will be governed by the inclosed, which is a copy of the instructions sent to Mr. Bond.

"I am, respectfully, &c.,

"J. K. PAULDING.

"Lieutenant J. M. GILLISS.

"*Instructions, &c., to be observed in making the series of observations during the absence of the Exploring Expedition, and in connection with it.*

"You will use every opportunity of taking observations of moon-culminating stars, confining yourself principally to those enumerated in the Nautical Almanac to be observed at Greenwich. As most of the stars are of the fifth and sixth magnitudes, you will, when opportunity offers, observe all those of the first and second magnitudes, particularly during the day, if any such offer. Although you will have a meridian-mark to refer to, [a mark placed on the parapet to the Capitol by Lieutenant Wilkes,] I should prefer your having resource to observations of high and low stars to prove your observations. * * * I would desire that your observations should be registered by a sidereal clock, in order to avoid any reduction for time equivalents. * * * If at any time you should not be able to make use of a sidereal clock, your observations ought, in all cases, to be corrected before the expiration of *twelve hours*, and marked in the column with its proper sign of application. You will lose no opportunity of making observations on any astronomical phenomenon, describing the place of its occurrence in the heavens. * * Your attention may be directed to any falling stars, particularly to those periodic ones in November. All eclipses you will, of course, be particular in observing, in order that, if any remarkable phenomenon should happen, we may have simultaneous observations of it. * * * The power of your telescope need not be over 240, and, generally, of 175 and 75; the lower power will be most suitable, as affording a clearer and flatter field. In noting any observations, you will be particular in mentioning the instrument and power used. In your journal, you will note the state

[1] Orders of Secretary Paulding and instructions to Lieutenant Gilliss, and to Mr. W. C. Bond, of Dorchester, Mass.

of the heavens, whether clear or cloudy, and the state of the atmosphere, as respects barometer, thermometer, and hygrometer. * * The eclipses of Jupiter's satellites frequently offer; they will be generally observed by me, and, I think, had better claim some attention from you; also, I would direct your attention somewhat to the occultations of all large stars, and the difference of observations as respects the disappearance and re-appearance of the star with the moon's limb. All of these observations will be most desirable during the year 1840. Observations on the perturbations, dip, and intensity of the magnetic needle would be very desirable."

Under these instructions, Lieutenant Gilliss himself made all the astronomical observations reported to the Secretary of the Navy, and published at Washington, July, 1846, except those of one day in 1838 and of two days in 1841. With these exceptions, there was not a visible culmination of the moon occuring, when the sun was less than one hour above the horizon, during the entire period from 1838 to 1842, nor an occultation after June 15, 1839, except that of 139 Tauri, which he did not personally observe.

His instructions had enabled him to obtain a portable 42-inch achromatic telescope, mounted parallactically; a variation transit, modified from Gambey's plan, so as to be used as a diurnal instrument in the bi-hourly observations; an 8-inch dip-circle; and a sidereal chronometer.[1] The observations commenced in September, 1838. The Transit was extremely deficient in optical power, and would not define stars smaller than the second magnitude when the sun was two hours above the horizon. The number of transits recorded exceeded 10,000, embracing the moon, planets, and about 1,100 stars. The average annual number of culminations of the moon observed was 110, and of lunar occultations about 20.[2]

Magnetical and Meteorological Observations.

Recognizing the astronomical observations as of paramount importance to the objects of the Exploring Expedition, (as the instructions distinctly implied,) Lieutenant Gilliss "hoped that a continued series in magnetism and meteorology also, carefully made, might prove, in some degree, useful to the solution of the great physical problem then under investigation by order of European governments, even if these observations could not bring to their recommendation the refinements of observatories specially established to that end. At all events, the subjects were new to the officers who would necessarily take part in them, and the experience consequent on their labors could not fail to benefit the naval profession."

Appreciating the arguments presented, the Secretary of the Navy authorized the purchase of new magnetic and meteorological instruments, and ordered additional assistants for the work at the Depot,

The Magnetic and Meteorological observations were made during the same years with the astronomical observations before referred to, in a frame building ten feet long by six feet wide erected for them in a position fifty feet south of the little observatory and forty feet northwest of the house occupied as a Depot for the charts and instruments.

[1] Two clocks, a sidereal and a mean-time, and a balance magnetometer, were subsequently obtained.

[2] Astronomical Observations made at Washington under order of the Secretary of the Navy dated August 13, 1838, printed by order of the Senate, 1846.

The record of the observations, together with a description of the declinometer, dip-circle, and magnetometer, and of the meteorological instruments used, forms the tenth volume of the Senate documents of 1844–'45.[1]

In making these astronomical and meteorological observations, Lieutenant Gilliss had the honor of being "the first in the United States who conducted a working Observatory, and the first who gave his whole time to practical astronomical work; it was he who first published a volume of observations, first prepared a catalogue of stars, and planned and carried into effect the construction of a working Observatory as contrasted with one intended chiefly for purposes of instruction. It was his privilege to be endowed with a wondrous acuteness of the perceptive powers of eye and ear. No one at all conversant with observations can examine the printed record without a vivid perception of this marked peculiarity."

In the long list of observers living and dead whose results were critically and searchingly tested by the so-called personal scale, he held the second place, by the testimony of Professor Peirce, who applied this test to the observations of 1838–'42.[2]

In 1845, after the establishment of the Observatory in its present location, Lieutenant Gilliss, in the close of his preface to the volume of these Astronomical Observations then issued, modestly says:

"It remains but for me to express my gratitude that the prosecution of these observations should have resulted in the foundation of a permanent Naval Observatory, and have obtained for me, though for a brief period, the privilege of association with many of the most distinguished astronomers of the present century."[3]

A permanent Depot recommended.

"As the observations progressed, the unsuitableness of the building, the defects of the Transit instrument, the want of space to erect a permanent circle, and the absolute necessity of rebuilding the observatory in use, became each day more urgent." At the earnest solicitation of Lieutenant Gilliss, the Commissioners of the Navy recommended an appropriation for a permanent establishment in December, 1841. Even this, however, was not accomplished without difficulty. But the interest of the honorable Secretary in advancing science, and more especially those branches of it in which the Navy is interested, induced him readily to appreciate its importance, and to bring the subject before Congress in his report to the President of December, 1841. He thus indorsed the recommendation of the Commissioners:

"Permit me to express my entire approval of the suggestion of the Commissioners, in relation to a suitable depot for the charts and instruments belonging to the Navy. These have been procured at great labor and expense, and are indispensable in the Naval service. The small expenditure which will be necessary to preserve them in a condition, always ready for use, is not worth a moment's consideration when compared with the great purposes they are designed to answer. They are a necessary part of a naval establishment worthy of the present and growing greatness of our country."[4]

[1] Magnetic and Meteorological Observations made at Washington under orders of the Secretary of the Navy dated August 13, 1838.

[2] Annual of the National Academy of Sciences for 1866, pp. 58 and 64.

[3] Lieutenant Gilliss's Report, February 7, 1845, p. 65.

[4] Report of Hon. A. P. Upshur, Secretary of the Navy, December 4, 1841.

The suggestion of the Navy Commissioners here referred to is to be found in their report to the Secretary of the Navy of November 30, 1841:

"The Board beg leave to call your attention to the subject of a '*permanent depot*' for the charts and instruments. * * The utility of this, as a matter of economy only, is fully manifested. * * To this may be added the facilities which such an establishment presents to officers of the Navy for obtaining useful, valuable, and indeed necessary knowledge in some branches of their profession." This report contained an estimate for buildings not to exceed $50,000, which could be commenced the ensuing season if half that sum were appropriated.

Lieutenant Gilliss proceeds in his narrative:

"Much delay occured with the Naval committees in Congress. The Hon. Francis Mallory, to whom it was referred by the House committee, espoused the cause warmly, but the majority kept aloof from the Depot (although so near) until the entire winter had passed away. Finally, on the 15th March, 1842, I succeeded in persuading the only member of the committee who was skeptical to visit the observatory, and on that very day a unanimous report and bill were presented to the House of Representatives. Believing the chances of success would be greater if a bill could be passed by the Senate, by the advice of Mr. Mallory I waited on the Naval committee of the Senate: but my entreaties for a personal inspection of our wants were put off from time to time. The question was probably decided by an astronomical event." The attention of the committee was gained by the following incident:

At a meeting of the National Institute, at which the Hon. William C. Preston was present, Lieutenant Gilliss gave notice of having found Encke's comet with the 3½-foot achromatic, the comet being then near its perihelion. A few days subsequently he made what was intended to be a last visit to the chairman of the Senate committee, and found Mr. Preston with him. As soon as he began the conversation about the little observatory, Mr. Preston inquired whether he had not given the notice of the comet at the Institute, and immediately volunteered, "I will do all I can to help you." Within a week a bill was passed by the Senate.

It is hardly necessary to trace its progress in the House. A majority was known to be favorable, but its number on the calendar, and the opposition of one or two members, was likely to prevent action upon it: for its receiving the sanction of the House of Representatives at the last hour of the session of 1841–'42, the Navy is indebted to the untiring exertions of Dr. Mallory.

The bill, which without discussion passed Congress, authorized the Secretary of the Navy to contract for the building of a suitable house for a depot of charts and instruments of the Navy on a plan not exceeding in cost $25,000, the sum of $10,000 being appropriated for the year; the Institution to be located on any portion of unappropriated public land in the District of Columbia which the President might deem suitable.[1]

Taking the report of the Naval committee which accompanied this bill as the exponent of the will of Congress, the Secretary of the Navy directed Lieutenant Gilliss to visit the northern cities for the purpose of obtaining information respecting a plan, which, while it combined essentials, should not exceed in cost the appropriated sum.

[1] Statutes at Large, vol. 5, p. 576. Bill approved August 31, 1842.

Professors Bache, Bartlett, Bond, Hassler, Paine, Patterson, and Walker were consulted, and the Department assigned G. F. De la Roche, esq., to draught plans under the direction of Lieutenant Gilliss.

THE OBSERVATORY OFFICIALLY RECOGNIZED.

The Observatory was now really established. It had become true, as remarked by Dr. Gould in his article entitled "U. S. Naval Observatory at Washington," in the National Almanac for 1864, that an Observatory under another name was established by act of that very Congress and at the very session in which they refused to pass Mr. Adams's bill for the same real object.

That the Secretary of the Navy was justified in this interpretation of the law appears to be clear enough by the following extracts from the accepted report of the committee taken, as Lieutenant Gilliss says, as the exponent of the will of Congress.

The committee say,[1] in reference to the value of a depot that "since its organization, the Navy has not only been furnished with better instruments and more recent charts, at a greatly less original cost than before, but greater care has been observed in their use, consequent upon the regulations of the Depot, making the masters of our public vessels directly responsible for each article delivered to them.

"Prior to that time, chronometers were purchased as the wants of a ship or the judgment of a commander dictated, without trial or examination, the only guarantee of its value being the word of the seller. Sextants which were rejected by experienced judges, and left as shop-keepers, too frequently found their way into the Navy, through the inability of navy-agents and store-keepers to discriminate between good and bad. A ship rarely went to sea without having the master's store-room half filled with wood compasses, from the prejudice that a light compass could only be obtained by making the bowl of that material. As a necessary consequence, the same set of instruments rarely went to sea two cruises. When the ship returned, they were tumbled into the Navy store, chronometers and all, where they remained till the fitting of a new ship would find them unworthy of further use. This no longer exists; Navy store-keepers are required to render a monthly report of every instrument in their charge; and, as before stated, masters are held directly accountable, so that, with a little additional repair at the end of each cruise, the same set lasts many years. The saving, from this cause alone, is more than the annual cost of the whole establishment."

In reference to ASTRONOMY, the committee say:

"In the summer of 1838, the honorable Secretary of the Navy directed the Superintendent to make a constant series of observations in astronomy, magnetism, and meteorology, ordering an additional number of assistants, and granting authority for the purchase of all necessary instruments.

"We are indebted to other nations for the data which enable our ships to cross the ocean. Not only has the Navy failed to contribute to the common stock from which all our navigators borrow, but our country has never yet published an observation of a celestial body which bore the impress 'by authority;' and it is believed that, until the observations before alluded to in this report, none have ever been directed by the Government which can be considered continuous.

[1] Mr. Mallory's Report. Twenty-seventh Congress, second session, report No. 449, House of Representatives; March 15, 1842.

"That great errors exist in the tabulated places of the heavenly bodies, the labors of astronomers of the present day sufficiently prove. Indeed, all who were at all curious in such matters could not have failed to remark how great a difference there was between the observed and computed times of the last annular eclipse visible in the United States.

"Observatories, though not expensive, cannot prosper in our country until we can obtain rest from the pursuit of mercantile affairs, or their charge is undertaken by the Government. The duties are confining; if properly executed, arduous; and but few are qualified by experience or habits to undertake them. If officers can be found with taste for such duties, an Observatory will give more information to the world, under a military organization, in one year, than under any other direction in two.

"The subject of MAGNETISM is scarcely less important to the Navy than astronomy. Without a knowledge of the variation of the compass, none but coasting-craft dare venture beyond the precincts of a harbor; yet how few have more than a practical knowledge of the mode of determining its amount. The daily changes of the variation, its extraordinary fluctuations during auroras, the causes, amounts, and modes of correcting the local attraction of ships, and, indeed, the laws governing magnetized bodies generally, are mysteries with which a large portion of the officers have had neither means nor opportunities to become acquainted. Great complaints are made that chronometers perform badly; that ships have been influenced by currents, when, if the true cause could be ascertained, it would be found to consist in having steered a wrong course, no allowance being made for local attraction. There can be no doubt a large number of the wrecks of shipping occur solely from this cause.

"The magnetic observatories which were established by the European governments two years since, and which have a location in almost every part of the world, were earnestly recommended to us by the learned men of England. Active and extensive co-operation, they say, will be the only mode of setting at rest the conflicting theories of this most important branch of science."

"In regard to METEOROLOGY, if Professor Espy's theory is correct, the day is not distant when we shall be able to calculate the precise point where a storm is raging.

"Meteorological observations are more important at night than by day, because of their scarcity hitherto; and it is scarcely to be expected that amateurs can be found in sufficient numbers to make all the required observations. Night-watching in stormy weather finds few followers, and we can only hope to obtain the desired information, when those engaged in its pursuit have *duty* to compel a flagging inclination.

"Deeming an establishment of this description essential to the welfare of the Navy, the committee report the accompanying bill."

It passed, as has been shown, without discussion in either House. To secure its passage good influences had been kindly set at work, directly and indirectly, by the friends of the Observatory in scientific circles.

Dr. Gould, in the article quoted on a preceding page says, of the labors of Professors Bartlett, Kendall, and Walker, as especially bearing on the establishment of the Institution:

"It is to them we owe the first important series of astronomical observations made in the United States, and it is to these and to their publications, *particularly the able report on European observatories*, by Professor W. H. C. Bartlett, United States Army, presented to the Engineer Department on returning from Europe, 1840, that we are indebted for much of that public sentiment which, combined with other influences, at last brought about the establishment of the Naval Observatory. Mr. Adams led the way; Lieutenant Gilliss had, by his diligent, careful, and successful observations, secured the all-essential confidence and co-operation of the Navy Department and of the Naval committees; but in shaping and confirming that public sentiment through which favorable action by Congress became probable, the influence of the other astronomers bore no inconsiderable part."

It has been with much regret that, after diligent inquiry, I have found it impossible to obtain a copy of a second report made by Professor Bartlett with a plan for a National Observatory. The Secretary of War, Mr. Poinsett, makes special commendatory reference to it in his report of 1840.

Renewed efforts of Hon. J. Q. Adams.

The action in the House of Representatives taken by the committee upon the Smithsonian fund under the leadership of Mr. Adams, had a powerful influence in the House in passing Mr. Mallory's bill. As far back, indeed, as June, 1838, when news was received of Mr. Rush's success in obtaining the Smithsonian bequest of more than half a million of dollars, Mr. Adams had immediately waited upon President Van Buren, and in a conversation of two hours explained the views he entertained in regard to the application of that fund, entreating him to have a plan proposed to recommend to Congress for the foundation of the Institution.

"I suggested to him," said Mr. Adams, "the establishment of an Astronomical Observatory, with a salary for an astronomer, and an assistant for nightly observations, and periodical publications; annual courses of lectures upon the natural, moral, and political sciences; above all, no jobbing, no sinecure, no monkish stalls for lazy idlers. I urged the deep responsibility of a nation to the world and to all posterity worthily 'to fulfill the great object of the testator.' I only lamented my inability to communicate half the solicitude with which my heart is on this subject full, and the sluggishness with which I failed properly to pursue it."

"Mr. Van Buren," Mr. Adams added, "received all this with complacency and apparent concurrence of opinion, seemed favorably disposed to my views, and willing to do right, and asked me to name any person who, I thought, might be usefully consulted."[1]

To a letter addressed to him by the Secretary of State, by direction of the President, requesting him to communicate the result of his reflections on the Smithsonian Institution, Mr. Adams made the following reply:[2]

"Quincy, *October* 14, 1838.

"Sir: I have reserved for a separate letter what I proposed to say in recommending the establishment of an Astronomical Observatory, at Washington, as one and the first

[1] Quincy's Memoirs, p. 191.

[2] Quoted by Mr. Adams in his report, No. 587, Twenty-seventh Congress, second session.

application of the annual income from the Smithsonian bequest; because, of all that I have to say, I deem it by far the most important; and because I have for many years believed that the national character of our country demanded of us the establishment of such an Institution as a debt of honor to the cause of science and to the world of civilized man. I have hailed with cheering hope this opportunity of removing the greatest obstacle which has hitherto disappointed the earnest wishes that I have entertained of witnessing before my departure for another world, now near at hand, the disappearance of a stain upon our good name, in the neglect to provide the means of increasing and diffusing knowledge among men, by a systematic and scientific series of observations on the phenomena of the numberless worlds suspended over our heads—the sublimest of the physical sciences, and that in which the field of future discovery is as unbounded as the universe itself. I allude to the continued and necessary expense of such an establishment."

Mr. Adams then refers to the report made by C. F. Mercer (quoted in part on p. 10 of this Memoir) for much valuable information, and proceeds:

"But, as it is desirable that the principal building, the Observatory itself, should be, for the purposes of observation, *unsurpassed by any other edifice constructed for the same purposes*, I would devote one year's interest from the fund to the construction of the buildings; a second and a third, to constitute a fund, from the income of which the salaries of the astronomer, his assistants and attendants, should be paid; a fourth and fifth, for the necessary instruments and books; a sixth and seventh, for a fund, from the income of which the expense should be defrayed of publishing the ephemeris of observation, and a yearly nautical almanac." * * * * * * * * * * *

"My principles for this disposal of funds are these:

"1st. That the most complete establishment of an Astronomical Observatory in the world should be founded by the United States of America; the whole expense of which, both its first cost and its perpetual maintenance, should be amply provided for, without costing one dollar either to the people or to the principal sum of the Smithsonian bequest.[1]

"2d. That, by providing from the income alone of the fund a supplementary fund from the interest of which all the salaries shall be paid, and all the annual expenses of publication shall be defrayed, the fund itself would, instead of being impaired, accumulate with the lapse of years. I do most fervently wish that this principle might be made the fundamental law, now and hereafter, so far as may be practicable, of all the appropriations of the Smithsonian bequest.

"3d. That by the establishment of an Observatory upon the largest and most liberal scale, and providing for the publication of a yearly nautical almanac, knowledge will be dispersed among men, the reputation of our country will rise to honor and reverence among the civilized nations of the earth, and our navigators and mariners on every ocean be no longer dependent on English or French observers or calculators for tables indispensable to conduct their path upon the deep."

In accordance with these views, Mr. Adams, in 1842, made a report to the House

[1] At a later date, Mr. Adams cordially assented to the different plan and basis on which the Smithsonian Institution has been established, the establishment of the Observatory having been secured.

of Representatives, accompanying it with a bill,[1] providing for the appropriation of the Smithsonian fund of $515,318.46 received by the United States, by the following enactments: The whole sum to be preserved undiminished and unimpaired, the faith of the United States being pledged thereto by its permanent investment as "the Smithsonian fund;" the sum of $30,000, part of the accruing interest, to be appropriated toward the erection of an Observatory; the sum of $60,000 of accrued interest to constitute a fund for payment by its interest of the salary of an astronomer; the sum of $120,000 of accrued interest to be appropriated for payment by its interest for the salaries of assistant observers; $30,000 for the best and most perfect instruments; $10,000 for the purchase of a library of science and literature; and $1,800 a year for the publication of astronomical observations and a nautical almanac.

In advocating the bill, the committee say:

"It is believed that no one science deserves or requires the immediate application of the accrued and accruing income of the fund so urgently as practical astronomy.

"The express object of an Observatory is the increase of knowledge by *new discovery*. The physical relations between the firmament of heaven and the globe allotted by the Creator of all to be the abode of man are discoverable only by the organ of the eye. Many of these relations are indispensable to the existence of human life, and, perhaps, of the earth itself. Who can conceive the idea of a world without a sun, but must connect with it the extinction of light and heat, of all animal life, of all vegetation and production; leaving the lifeless clod of matter to return to the primitive state of chaos, or to be consumed by elemental fire? The influence of the moon, of the planets—our next-door neighbors of the solar system—of the fixed stars, scattered over the blue expanse in multitudes exceeding the power of human computation and at distances of which Imagination herself can form no distinct conception; the influence of all these upon the globe which we inhabit, and upon the condition of man, its dying and deathless inhabitant, is great and mysterious, and, in the search for final causes, to a great degree inscrutable to his finite and limited faculties. The extent to which they are discoverable is, and must remain, unknown; but, to the vigilance of a sleepless eye, to the toil of a tireless hand, and to the meditations of a thinking, combining, and analyzing mind, secrets are successively revealed, not only of the deepest import to the welfare of man in his earthly career, but which seem to lift him from the earth to the threshold of his eternal abode; to lead him blindfold up to the council-chamber of Omnipotence, and there, stripping the bandage from his eyes, bid him look undazzled at the throne of God." * * * * * *

"It is to the successive *discoveries* of persevering astronomical observation through a period of fifty centuries that we are indebted for a fixed and permanent standard for the measurement of time. And by the same science has man acquired, so far as he possesses it, a standard for the measurement of space. A standard for the measurement of the dimensions and distances of the fixed stars from ourselves is yet to be found, and, if ever found, will be through the means of astronomical observation. The influence of all these discoveries upon the condition of man is, no doubt, infinitely diversi-

[1] Reports of Committees, vol. 3, Twenty-seventh Congress, second session, House of Representatives, report No. 587, bill 386; 1841–'42.

fied in relative importance: but all, even the minutest, contribute to the increase and diffusion of knowledge. There is no richer field of science opened to the exploration of man in search of knowledge than astronomical observation; nor is there, in the opinion of this committee, any duty more impressively incumbent upon all human governments than that of furnishing means and facilities and rewards to those who devote the labors of their lives to the indefatigable industry, the unceasing vigilance, and the bright intelligence indispensable to success in these pursuits.

* * * *. "It was an observation of Voltaire that if the whole human race could be assembled in one mass, from the creation of man to his time, in the graduation of genius among them all, Isaac Newton would stand at their head. But the discoveries of Newton were the results of calculations founded upon the *observations* of others—of Copernicus, of Tycho Brahe, of Kepler, of Flamsteed; and among their producing causes not the least was the erection and establishment of the Royal Observatory of Greenwich.

"The original purpose of this Institution, first commenced in 1676 under the patronage of Charles the Second, and the most glorious incident of his life, was for the finding out the so much desired longitudes of places for the perfecting the art of navigation; and the inscription still existing above the original door of the Observatory declares that it was built for the benefit of astronomy and navigation: so intimately connected together are the abstracted science and the practical art, that, without the help of the astronomer, the seaman could not urge his bark in safety one inch beyond the sight of the shore.

* * * "The discovery of the longitudes of places, the benefit of astronomy and navigation were thus the declared objects of the erecting of the Greenwich Observatory, and of the appointment of Flamsteed *Astronomical Observator*. And what were the first fruits of that Institution?

"1. An increased accuracy of observation by the attachment of telescopes to graduated instruments, and by the use of a clock to note the time at which stars and planets passed by their apparent diurnal motion across the middle of the field of view of the telescope.

"2. A catalogue of the places of 3,310 stars with a name affixed to each, the selection and nomenclature of which have served as a basis to every catalogue since that time. Nor is it an uninteresting incident in the progressive history of astronomical knowledge that when, one hundred years later, Herschel discovered that the star which bears his name was a planet, he found it a fixed star upon the catalogue of Flamsteed.

"3. Many of Flamsteed's observations of the moon, reduced as well as was practicable, were, at Newton's request, communicated to him, to aid in perfecting the theory deduced from the principle of universal gravitation. 'The time,' as has been well observed by the present Astronomer Royal, the Reverend George Biddell Airy, 'the time at which these observations were made was a most critical one—when the most accurate observations that had been made were needed for the support of the most extensive philosophical theory that man had invented.' * * * *

* * * * "From such small beginnings originated, and thus illustrious has been the career of the Royal Observatory of Greenwich. Originally attached to the Ord-

nance Department, it was, in 1816 or 1817, transferred to the Department of the Admiralty. The estimates for the annual expense of the Observatory are inserted under the 'scientific branch' of the Admiralty account in the parliamentary estimates, and are voted annually by Parliament."

Before closing the report, the committee further reminded Congress of the large increase in the number of observatories in Europe, and of the inauguration of the Pulkova Observatory on the 7th August of the preceding year, at a cost of 1,000,000 silver rubles, on a spot chosen by the Emperor Nicholas, for the best appointed Institution in the world. They appended to their report a very full letter from Reverend G. B. Airy, Astronomer Royal, which epitomizes the history of the Greenwich Observatory up to the date of April 10, 1839, and which also presents much miscellaneous information relating to other Observatories.

Of this report by the Committee the remark has been made by a competent judge that it is "well worth the perusal of every lover of the glorious science of astronomy, both for the richness of its information and the beauty of its eloquence." The persevering labors and deep personal interest of Mr. Adams in the object of establishing an Observatory are readily understood when his love for the study of astronomy is remembered in connection with his masterly scholarship in many other branches of learning and with his wide national views. His own journal in the year when he was laboring for the erection of a National Observatory records: "To make observations of the movements of the heavenly bodies has been for a great portion of my life a pleasure of gratified curiosity, of ever returning wonder, and of reverence for the Great Creator and Mover of these innumerable worlds." His oration in 1843, at the laying of the corner-stone of the Cincinnati Observatory, is "an outline of the history of astronomy." His studies had been the works of Newton, Schubert, Lalande, Biot, and Lacroix.

I find in the records of the House of Representatives of the same year that additional influences were brought to bear upon the bill for a Depot of Charts and Instruments. Among them was the following:

May 12, 1842, Hon. Mr. Boardman, from a select committee, reported on the memorials of P. S. Duponceau and other citizens of Philadelphia, New York, and Baltimore, praying Congress to take measures for the reduction of Astronomical Observations and for the precise determination of the longitude of the Capitol, in substance as follows:[1]

"The substantial interests and honor of the country require this; it is due to the cause of science and to that sublime branch of it which contemplates the relation of the earth to the heavens. It is incumbent on Congress to provide for the safety of our mariners and of the immense treasures which the enterprise of our merchants throws daily upon the waters. It is by celestial observations only that charts can be accurately projected. * * *

"In Europe the whole expense of *observatories* and instruments is borne by the government. The purposes and objects are there regarded as purely national and of sufficient importance to command constant and liberal appropriations. We are the

[1] Twenty-seventh Congress, second session, House of Representatives, Report No. 633, bill 410.

second commercial nation in the world, and yet we have thus far done but little for the advancement of a science so deeply important to the interest of navigation. * *

"After the example of the European nations, Congress has fixed upon the meridian of this Capitol as our prime meridian, and has, in some degree, determined its longitude from the European capitals by their action on the report of Mr. Lambert in 1822.[1]

"The memorialists state that through the accumulated astronomical observations since the adoption of that report, there is reason to suspect an error in his position of the Capitol; that this error is incorporated in all our maps; and that Mr. Lambert in his report had omitted to correct his results for the errors of Burg's lunar tables then in use, although Dr. Bowditch's Memoir would have enabled him to correct them; that the number of astronomical observations in possession of the Navy Department and of learned societies unreduced, together with those from other sources available for national purposes, is probably more than a thousand."

The memorialists refer to the communications of Hon. John Branch Secretary of the Navy in 1830, upon the objects of erecting an Observatory, and ask the appointment of a computer and assistants, who shall reduce the entire mass of observations on a uniform system.

A bill to meet the object asked for by the memorialists was reported and committed to the committee of the Whole House. Although no final action was taken, the discussion of this subject (as well as that of a memorial presented not long before from the American Philosophical Society of Philadelphia, asking aid in prosecuting magnetic and meteorological observations) was not without its influence in securing the new movement which Lieutenant Gilliss so ardently desired and in the same year obtained.

Erection of the Observatory.

On the 23d of November, 1843, Lieutenant Gilliss reported to the Navy Department the adoption of a plan for an Observatory, modified as advised by distinguished gentlemen in Europe and in the United States; he also reported the progress of the erection of the building in accordance with the plan.

In noticing this communication, the Secretary of the Navy said in his next annual report:[2] "It is proper to remark that this building is adapted in form and structure not only for a Depot of Charts and Instruments, but for an Astronomical Observatory. It cannot but be gratifying to you to learn how great an interest has been evinced by the learned societies and scientific men of Europe as well as at home, upon the establishment of the Institution by the Government."

The law of Congress directing its erection authorized the President of the United States to locate it on any public ground within the District of Columbia not otherwise appropriated; and the site assigned by President Tyler was the Reservation marked, on the original plan of the city, No. 4, as will presently be more fully shown. It lies

[1] As regards the official sanction finally given by Congress for a first meridian, the statute of September 28, 1850, is known as the only law authorizing our reckoning. It provides that hereafter the meridian of the Observatory at Washington shall be adopted and used as the American meridian for all astronomical purposes, and that the meridian of Greenwich shall be adopted for all nautical purposes.

[2] Report of Hon. D. Henshaw, Secretary of the Navy, November 25, 1843.

on the north bank of the Potomac, in the southwestern part of the city; the north front being 810, the east 1,103, and the west 620 feet in length.

"The site has a north horizontal range, one and a quarter mile, and a south range of eight miles. It is 267 feet from the north; 320, from the east; 490, from the west; and 900, from the south inclosure; the last bordering on the canal, beyond which is the river. The hill is of gravel foundation, with a surface stratum of dry, brittle clay, through which water filters almost as freely as through gravel."

In addition to these statements by Lieutenant Gilliss, I have found the following interesting information as regards—

The Site of the Present Observatory.

The earliest trace on the records identifying the lands now occupied is in connection with the march of General Braddock against Fort Duquesne in the Colonial Wars. It seems clear that his troops landed and encamped on this hill.

The record is this:[1]

"April 11, 1755. Four companies of the Forty-fourth Regiment under Lieutenant (afterward Governor) Gage, and a detachment of seamen from Alexandria, landed from the boats of the Sea Horse and the Nightingale, and pitched their tents '*at* Rock Creek.' April 14, General Braddock arrived *at* Rock Creek, and gave orders for transporting the stores; the troops marched from 'Rock Creek' to Owen's house, fifteen miles onward to Frederick." (Rockville.) Traditions are strong as to the camping on this Hill.

Washington's letters show that he afterward crossed here also from Alexandria to join Braddock at Frederick.

The late Colonel Peter Force, of Washington, so well known for his historical collections, repeatedly pointed out the large rock, which yet stands, in the southern part of the original Reservation which the Observatory occupies, as the rock on which these landings were made. The northern channel of the Potomac, it is well known, was good here until our day—until the causeway for the Long Bridge was made.

The second identification of the locality is of more direct interest and value.

In the office of the Commissioner of Public Buildings may be found the original "Plan of the Federal City"—not then named Washington—as presented by the first Commissioners, David Stuart, Daniel Carroll, and Thomas Johnson, appointed under the act of Congress, July 16, 1790, to lay out the city and take measures for the erection of the Federal buildings.

On this manuscript plan, communicated to Congress, December 13, 1791, the grounds on which the Observatory now stands are marked as a blank space with the number "4" upon it. On the engraved plan, published by order of General Washington by Thackara and Vallance, Philadelphia, 1792, the northern and central part of the square is covered by the lines of a proposed fort and barracks.

With the original manuscript plan are connected two letters, the one bearing the autograph of Geo. Washington, and dated March 2, 1797; the other, that of John Adams, July 23, 1798; each letter requesting Thomas Beall of Geo. and Jno. M.

[1] Braddock's Expedition by Winthrop Sargent, p. 367.

Gantt to convey to the Commissioners of that date, Gustavus Scott, W. Thornton, and A. White, and to their successors, "all the streets, squares, and parcels of ground designated as appropriations, for the use of the United States forever." These appropriations or reservations were sold to the United States by the original proprietors for £25 per acre = $86⅔ United States currency, the spaces for the streets being not counted. The proprietor of space No. 4, Mr. Robert Peter, gave one-half of the area, and received from the Commissioners in exchange for the other half another parcel of ground.

In General Washington's letter,[1] Reservation No. 4 is thus described:

"Fourth. The *appropriation* bounded on the north by the south side of north E street; on the east by the west side of Twenty-third street west; on the west by the east side of Twenty-fifth street west; and on the south by the Potomac River."

The historical value of the record just cited is increased by the fact that, at a date earlier by many years than the official occupancy of this square, it was proposed to make it the site of an Institution of science,[2] the proposal being by the first President and the Commissioners to locate here a National University. At a much later date it was proposed by President Adams as the site of an Observatory. Of the first of these points the following is on record:

In President Washington's letter to the Commissioners, January 28, 1795,[3] he names to them his well-known offer to donate certain shares in the Potomac Company for the purposes of a National University, adding, "If the commissioners have any agency in bringing the matter forward, the information I now give them is in the proper course." In his letter to John Adams, November 27, 1794, and in his speech to Congress, January 8, 1790, he had previously expressed a like desire on this subject.

The Commissioners, February 18, 1795, reply:[4] "Your letter relates to a subject on which we have often conversed together, and we cannot express the satisfaction it gives us to find your opinions on the subject so consonant with our own. * * * We have chosen a piece of ground which, if approved by you, is intended for the site." In their second answer, October 1, 1796, they say, "With respect to a National University we are of the opinion that the space *heretofore proposed* to be appropriated for a *fort* and *barracks* on Peter's hill is the most proper site for that object." In Washington's letter to the Commissioners, October 21, 1796, he notifies them, * * "For a site of the National University, I decide in favor of the squares surrounded by numbers 21, 22, 34, 45, 61–63."

A reference to the map of the city of Washington of a later date than 1796 will not show the squares 34 and 45: they appear, however, on the map placed before General Washington, facing north on E street north; the appropriation faces also south on the Potomac.

In 1796, December 21, Mr. Madison, reporting favorably to the House of Representatives on a memorial of the Commissioners, and upon President Washington's second

[1] Washington's letter to the Commissioners, 1797. First official sanction of the reservation now occupied by the Observatory.

[2] Designation of the reservation for a scientific institution. Washington's letter, October 21, 1796. President Adams's message, December 6, 1825.

[3] Sparks's Writings of Washington, vols. xi and xii.

[4] Letters of the Commissioners in the office of the Commissioner of Public Buildings.

recommendation for a university, says:[1] "The proprietors of the lands by their deeds of cession authorized the President of the United States for the time being to appropriate such portions thereof as he should judge necessary to public use. In virtue of this power, the President has appropriated nineteen acres one rood and twenty-one perches for the site of a National University."

As regards the accuracy of the original survey of this and of the other portions of the city, it is stated on the original engraved plan that Major Andrew Ellicott, (the geographer-general as named by the Commissioners, appointed in 1792 surveyor-general of the United States,) drew a true meridional line by celestial observations, which passed through the area intended for the Capitol, crossing it by another line due east and west passing through the same area; running all the lines of the city by a Transit instrument and determining the acute angles by actual measurement, leaving nothing to the uncertainty of the compass." On the plan of the city the Capitol is marked, latitude 38° 53′.

The elevation now occupied by the Observatory was again known as Camp Hill, from its having been occupied by a part of the American army encamped on it in the years 1813 and 1814. A brigade of militia, including Stull's and Peter's riflemen and the troops from Alexandria, advanced from this hill to the vicinity of Bladensburg, for the defense of the city against General Ross and Admiral Cockburn, August 23, 1814.[2]

As a final point of interest in connection with the Observatory reservation, it may be mentioned that in the report of Lieutenant-Colonel G. W. Hughes to the Secretary of War, January 15, 1851, on the subject of supplying water to the city, reference is made to the "numerous surveys made contemporary with the first plans of the city" for the same purpose of the water-supply. Major Ellicott had reported on these plans, in 1791–'92, that the positions of the several squares were first determined on the most advantageous ground, commanding the most extensive prospects, and susceptible of improvement. The level of the base of the Observatory is one of those positions. They were chosen in 1851 by Colonel Hughes, and afterward by Lieutenant (now Major-General) M. C. Meigs, U. S. A., as the more elevated points of comparison within the city above ordinary low tide. The levels given by the report of Colonel Hughes are as follows:[3]

Foundation of St. John's Church	65.50 feet.
Corner of I and Nineteenth streets, west	82.10 feet.
Base of Observatory	96.20 feet.
East base of Capitol	89.50 feet.
Corner of N and Eleventh streets ("highest point in the city")	103.70 feet.

By levels taken also by Lieutenant (now Rear-Admiral) B. F. Sands, at the time of the first occupancy by the Observatory of its present site, the base of the Observatory was found to be on a level with the floor of the Congressional Library.

It thus appears that the level of the base of the Observatory is the second highest eminence within the city limits: a fact which, in connection with others, doubtless had

[1] American Miscellaneous State Papers, vol. 1, p. 153.

[2] National Intelligencer, August 24, 1814.

[3] Reports of March 3, 1851, and February 12, 1853, House of Representatives, Thirty-first Congress, second session, Ex. Doc. No. 33, and Ex. Doc. No. 48, Senate, Thirty second Congress, second session.

weight in its choice by the first President and the Commissioners, and subsequently by President Adams for the seat of a Scientific Institution. The founders of the Government, selecting this eminence at first for military occupancy and defense, (for which purposes it has been more than once used,) yielded promptly their first choice for the permanent occupancy of the site by an institution of peace. Have not they, and all others in official and private life up to this day, expected the faithful preservation of the high purposes of the reservation and of its beautiful eminence?

Erection of the Buildings.

In February, 1845, Hon. J. Y. Mason, communicated to the Senate a report,[1] and the drawings accompanying the same, by Lieutenant J. M. Gilliss, on the erection of a building in Washington as a 'Depot for Charts and Instruments.'

This report, from which extracts have been already made, was a complete description of the building then erected, and of the astronomical and magnetical instruments to be used. It occupies nearly eighty pages of text, with ten plates descriptive of the instruments. The changes which have been made since the date of that report, in the plan of the building and in some of the instruments, and the yet more important improvements now in progress, are substantial reasons for not accompanying this Memoir with any reproduction of the plates or with descriptions of the instruments.[2] But as it will be found almost impossible to secure now a copy of Lieutenant Gilliss's report, citations of some length are here made, as called for in making up even an outline of the Institution as it was when established in 1842.

Construction of the Main Buildings.

"The ground was excavated to a depth of 8 feet for the foundations of the walls and bases of all the piers, except that for the great telescope, which is 9 feet below the surface of the ground.[3] The end wall of the west wing and foundation for meridian-transit piers are several feet deeper than the others, owing to a natural fall in the ground rendering it necessary to excavate to a greater depth. Directions had been given to go down to the gravel, subsequently found at 27 feet from the surface.

* * * "The position of the house being changed 25 feet to the west, the east wall and pier for the portable transit instrument fell within the cavity; they were therefore built up of solid masonry from the depth of 17 feet below the surface, instead of filling the hole with earth.

"The central building is 50 feet 8 inches square on the outside, from the foundation to a height of 2 feet 6 inches above the ground: and thence to the top of the walls, 50 feet square. All the foundations to the ground-line are of blue rock, 2 feet thick; the remainder of the outside walls are of brick, 18 inches thick, finished in the best manner; and the partition-walls are of brick, 14 inches thick. It is two stories and a basement high, with a parapet and balustrade of wood around the top, and is surmounted by a revolving dome, 23 feet in diameter, resting on a circular wall, built up to a height of

[1] Report of the Secretary of the Navy, February 17, 1845, Twenty-eighth Congress, second session; Senate Ex. Doc. No. 114.

[2] For these see Washington Astronomical Observations for the Years 1845, 1865 and 1870.

[3] Gilliss's Report, 1845, p. 3.

7 feet above the roof. Its roof is nearly flat, having a rise of only one foot in ten; it is coppered and covered with a grating resting on supports secured to the parapet on one side and the roof on the other, so as to form a level promenade for gazing observations. There are four rooms on each floor, separated by passages 10 feet wide, crossing each other at right angles. Where the dome-wall crosses the passages, it is supported on lintels formed by bolting together five thicknesses of timber, 12 inches wide by 4 inches thick, over which a brick arch is turned. There is, at the intersection of the passages, a foundation of masonry, laid in hydraulic cement, for the great pier. Its diameter at the base is 15 feet, and it is solid to the height of 10½ feet, where the diameter is 12 feet.

"Upon this is erected a conical pier of hard burned brick, laid in the same manner; the diameter at the base being 12 feet, the height 28 feet, diameter at the top 7 feet, and walls 3 feet thick, to within 10 feet of the top, where they gradually increase in thickness; and the last 3 feet are solid. The pier is capped by New York flagging-stone, on which rests the pedestal of the equatorial.

"Stairways from the basement to the second story are of the ordinary kind; but from the second story to the rotunda or dome they are spiral; commencing beside the vertical casing, (which prevents contact with the great pier,) they proceed to a landing at the circumference of the dome, the aperture in the floor being closed by closely-fitting doors, which are kept up by counter weights when the observer is not employed. * *

"To the east and west sides of this edifice are wings, entered from the passages, each 26 feet 6 inches long, 21 feet wide, and 18 feet high. There is also a wing to the south, separated from the house by an entry or passage 10 feet square;—it is 21 feet long, with the same breadth and height as the others. To guard against unequal temperatures likely to be produced by the heated walls of the house, (on the suggestion of Professor Encke,) an extra 9-inch wall is interposed, leaving a space of 6 inches for free passage to the air between them. The side-walls of the wings are 18 inches, and the end-walls 14 inches thick, the former being strengthened by pilasters on each side of the doors."

Astronomical, Magnetic, and Meteorological Instruments.

In regard to the equipment of the Observatory with instruments, Lieutenant Gilliss reported as follows:

"It being evident, from the report of the committee of Congress before named, that it was intended to establish a Naval Observatory in connection with the Depot of Charts and Instruments, it became an object of great importance to obtain instruments of such character in the various departments of astronomy, terrestrial magnetism, and meteorology (designated by them to be pursued) as would render the most efficient service during the largest portion of time. To this end, eminent advice was sought, and a list prepared for the approval of the Hon. Secretary, which, regarding their ultimate usefulness as paramount, still kept economy in view.

"The list embraced

"1. Achromatic refractor.

"2. Meridian transit.

"3. Prime vertical transit.

"4. Mural circle.
"5. Comet-searcher.
"6. Magnetic instruments.
"7. Meteorological instruments.
"8. Books."

"In addition to these, to be purchased, there belonged to the Navy a portable 42-inch Transit instrument and 2 clocks purchased by Lieutenant Wilkes for the Exploring Expedition, and a 30-inch Transit circle and 2 clocks ordered for the Depot; all of which, with a number of mathematical, astronomical, and other scientific books, could be rendered useful in the new establishment."

Two other astronomical clocks were ordered; one for the south wing, and the other for the east wing; the former being the workmanship of Mr. Charles Frodsham, London, and the latter of Mr. W. C. Bond, Boston.

The magnetical instruments purchased under the advice of Professor Lloyd and Colonel Sabine were ordered from Barrow, London. They were a declinometer, bifilar magnetometer, balance magnetometer, and Fox's deflector. The meteorological instruments were a standard barometer of the value of £20, dry and wet bulb and self-registering thermometers, Daniell's hygrometer, and Osler's anemometer, and rain-gauge.

"In token of the interest and gratification at the establishment of the Institution felt by distinguished men abroad, the

Library of the Observatory

received, among its first stores, contributions of 175 volumes from the Royal Society, Royal Astronomical Society, the English Admiralty, and the East India Company, and from the Astronomers Royal at Greenwich, Berlin, Brussels, and Munich, and the directors of other distinguished observatories. The United States Observatory was immediately placed upon their exchange-lists. Seven hundred volumes of standard works were purchased.

Superintendency of Lieutenant M. F. Maury, 1844 to 1861.

At the close of September, 1844, Lieutenant Gilliss reported to the Hon. Secretary of the Navy that the new building was ready for occupancy and the instruments adjusted. October 1, Lieutenant M. F. Maury, then Superintendent of the Depot of Charts, was ordered to take charge of the new Depot and Observatory, and to remove to it all the nautical books, charts, and instruments, with the officers who were at that time attached to the Depot. These officers were Lieutenant (now Rear-Admiral) B. F. Sands, who was placed in charge of all the instruments and charts; Lieutenants W. L. Herndon and G. H. Scott, with Passed Midshipmen J. L. Worden, (now Rear-Admiral:) R. H. Getty, J. M. B. Clitz, J. F. Stenson, W. B. Fitzgerald, and M. K. Warrington.[1]

With the aid and supervision of these officers, the instruments and charts were immediately removed from the building, then rented by the Government, now known

[1] Report of Lieutenant Maury to the Secretary of the Navy, in Appendix to the Washington Observations for 1845.

as Nos. 2222 and 2224 Pennsylvania avenue, which building had been occupied as the Depot from July 1, 1842.

Between the dates of October 1, 1844, and July 1, 1846, the following officers were ordered to the Observatory: Lieutenants T. J. Page, L. Maynard, D. D. Porter, W. B. Whiting, and J. J. Almy; Professors J. H. C. Coffin, J. S. Hubbard, and R. Keith. Mr. S. C. Walker, of Philadelphia, was also appointed an assistant astronomer. From time to time a number of passed midshipmen were ordered: the changes in the orders of these junior officers, however, being too frequent to permit much valuable results from their labors.

Among the names which have been given may be recognized some which have become national, and associated with memories of a nation's gratitude earned by gallant naval service in the late struggle for the preservation of our country and her liberties.[1]

Extensive Astronomical Work Proposed.

On the 6th March, 1846, the Superintendent, Lieutenant Maury, obtained the following order from Hon. Geo. Bancroft, Secretary of the Navy:

"Sir: Desirous that the numerous and able corps employed at the National Observatory at Washington may produce results important to maritime science and to the Navy, I approve your course in making the series of astronomical observations necessary for the preparation of a nautical almanac.

"The country expects also that the Observatory will make adequate contributions to astronomical science. The most celebrated European catalogues of the stars, 'Bessel's Zone Observations' and 'Struve's Dorpat Catalogue' of double stars, having extended to only 15° south of the equator, and the Washington Observatory by its geographical position commanding a zone of 15° farther south, and being provided with all instruments requisite for extending these catalogues, you are hereby authorized and directed to enter upon the observation of the heavens, commencing at the lowest parallel of south declination you may find practicable. You will embrace in your catalogue all stars, even of the smallest magnitude, which your instruments can accurately observe. You will, when convenient, make duplicate observations of stars for each catalogue, and, when time permits, you will determine with precision, by the meridian instruments, the position of the principal stars in each pair or multiple of stars. Simultaneously with these observations you will, as far as practicable, determine the positions of such stars as have different declinations or right ascensions assigned to them in the most accredited ephemerides."

How far the astronomical force of the Institution was able successfully to meet the requirements of this order will appear in the volumes subsequently issued from the Observatory.

It has been said[2] that the work was to be nothing less than assigning color, position, and magnitude to every star in the heavens which could be seen with the instruments—a noble work. Unfortunately, under the circumstances of the Observatory, it would have required a century to complete it.

[1] National Almanac, 1864.

[2] North American Review, October, 1867.

The work of making this catalogue of stars down to the 9.10 magnitude was begun in 1846 with three meridian instruments, the mural, and meridian circles, and the transit instrument, by Professors Coffin, Hubbard, and Keith, and Lieutenant T. J. Page.[1]

Publication of the First Volume of Observations.

In September, 1846, the volume of observations made during the year 1845 was issued from the press. At the close of the Superintendent's letter to the Hon. Secretary of the Navy forwarding these observations, after repeated statements of the insufficiency in the strength of his astronomical force, he says: "After this year, I purpose to continue the great American work of penetrating regularly and systematically every point of space above the almucantar of 5°. * * * * I have now the honor of presenting the first volume of astronomical observations ever issued from an institution properly entitled to the name of an observatory on this side of the Atlantic."

An impartial and able judge thus estimates the volume: "Besides a fair amount of observations with the two transit instruments, in the meridian and the prime vertical, and those with the mural circle, it contained various important investigations of the errors and corrections peculiar to the instruments; Professor Coffin's masterly discussion of the adjustments of the mural circle, and his expansion of Bessel's Refraction Tables, Walker's investigation of the latitude of the Observatory, and his comparison of the standard thermometers; all of great value." The observers during the year were, with the equatorial, Lieutenant Maury and Mr. S. C. Walker; with the mural circle, Professor Coffin and Lieutenant T. J. Page; with the meridian circle, Lieutenant (now Admiral) D. D. Porter and Professor Hubbard; with the west transit, Lieutenants Maynard and Almy and Professor Keith.

In a table of comparison of the cost of the Chronometers and other Naval Instruments, presented also in this volume, (Appendix, p. 6,) the Superintendent showed the large reduction in the cost of these from the prices paid by the Government before the establishment of the Depot of Charts in 1830.

The Secretary of the Navy, in his annual report for the succeeding year, renewed the statement that, with the facilities of the Observatory, we might produce our own Nautical Ephemeris, a small appropriation being sufficient to accomplish the object, the expenditure of which would be returned by supplying our merchant-vessels with nautical almanacs at cost.[2]

[1] This work, as projected in 1846, was continued during the years following up to and inclusive of the year 1849; "the corps of computers proving, however, altogether insufficient to keep pace with the observers." The observations of the zones made during the year 1846 with the meridian circle by Professor J. S. Hubbard and Lieutenant L. Maynard were reduced under the direction of M. James Ferguson, assistant astronomer, and published in 1860 as volume I, of Zones of Stars.

The zones observed in 1846,–'49, with the mural circle, by Professor J. H. C. Coffin[1], Lieutenants T. J. Page and Charles Steedman, were published in 1872 as Appendix No. II to Washington Observations for 1869. The transit-instrument observations for the same years by Professors Keith[2], Beecher[3], and Hubbard[4], and Lieutenant (now Commodore) J. J. Almy, and Lieutenant W. A. Parker, have just issued from the press. The meridian-circle observations for the years 1847–'49 are ready for the printer. By authority of the Navy Department, given in 1862, all these zone observations for the years 1846–'49, were reduced by Dr. B. A. Gould, then of Cambridge, Massachusetts, now director at Cordoba, of the National Observatory of the Argentine Republic.

[2] Report of Secretary Upshur, December 5, 1846.

[1] J. H. C. Coffin, appointed Professor of mathematics January 23, 1836; commissioned August 14, 1848.
[2] R. Keith, appointed Professor of mathematics August 17, 1845; commissioned August 14, 1848.
[3] M. Beecher, appointed Professor of mathematics June 14, 1841; commissioned August 14, 1848.
[4] J. S. Hubbard, appointed Professor of mathematics May 5, 1845; commissioned August 14, 1848.

Identification of Neptune with a Star of Lalande's Catalogue of 1795.

In the second volume of the Washington Astronomical Observations, Lieutenant Maury says of this discovery:

"In the autumn of 1846, after the planet Neptune had been discovered by Leverrier, and seen by Dr. Galle, it was made the duty of Mr. Walker, one of the assistants, to endeavor to trace the path of the planet backward, in order to ascertain if it had not been discovered by some astronomer before, and entered among his observations as a fixed star. February 1, 1847, he reported a list of 14 stars from Lalande's Catalogue which answered the description of the planet, and near the places of which he made Neptune to be in May, 1795, when the French astronomer observed these stars for his great work, the '*Histoire celeste*.' The list was given to Professor Hubbard, in charge of the equatorial, who reported, February 4, that the one which Mr. Walker had singled out as the star most likely not to be found in that part of the heavens where Lalande saw it was missing. It turned out to be Neptune, and that Lalande, not suspecting it to be a planet, had observed and recorded it as a fixed star May 8 and 10, 1795."

Astronomers were thus furnished with an observation of Neptune made fifty-two years before, which afforded the means of a most accurate determination of the orbit, and enabled the Superintendent of the American Nautical Almanac to publish an ephemeris of the new planet two years in advance of all other parts of the almanac.

The Observatory was first brought into prominence by these researches.[1]

The Superintendent of the American Nautical Almanac, Lieutenant (now Rear-Admiral) C. H. Davis, at the later date of October, 1849, wrote to the Hon. Secretary of the Navy: "The theory of Neptune belongs, by right of precedence, to American science. In connection with its neighbor, Uranus, it constitutes an open field of astronomical research, into which the astronomers and mathematicians of the United States have been the first to enter, and to occupy distinguished places. The identity of Neptune with the Lalande star of 1795 (an important fact in history) was discovered at the Naval Observatory, and the discovery was due to the investigations of Mr. Walker."[2]

Work of the Observatory from 1847 to 1850.

The Observations made during the year 1847 were published in 1853; those made in 1848, in 1856; those made in the years 1849 and 1850, in 1859.[3]

The observations during the years 1847–'50 were with the Equatorial, by Professor Hubbard, and afterward by Mr. James Ferguson, (appointed Assistant Astronomer March 11, 1848); with the Mural Circle, by Professor Coffin, United States

[1] Proceedings of the American Association, 1854.

[2] For Walker's full report of this discovery, see Smithsonian Contributions, vol. II, as referred to by Lieutenant Maury; for Walker's Ephemeris of Neptune for 1852, with the letter of the Superintendent of the Nautical Almanac, see Smithsonian Contributions, vol. III.

[3] Those made in the years 1851–'52 were not reduced, nor were any other volumes than those of the three periods named above, issued during Lieutenant Maury's superintendency. The observations for 1851–'52, transcribed from the note-books in 1861 under Mr. Ferguson's supervision, were reduced and prepared for publication in 1862 by Dr. B. A. Gould, of Cambridge, Massachusetts.

Navy, and Lieutenant (now Rear-Admiral) Steedman, with the MERIDIAN CIRCLE, by Professors Hubbard and Major;[1] with the PRIME VERTICAL, by Lieutenant Herndon and Professors Hubbard and Lawrence. In the reduction of some of these observations several other naval officers were employed at various dates, among whom were the then Lieutenants Kennard, Jackson, Almy, and Worden, and Lieutenant (now Commodore) D. Ammen, Chief of the Bureau of Navigation.

The volume for the year 1847 contains three Appendixes: "A," Observations of Solar Spots by Rev. B. Sestini, S. J., of Georgetown College, D. C., made at the college; "B," Observations on the Mississippi River at Memphis, by R. A. Marr, Passed Midshipman United States Navy; "C," Tables for the Reductions of the Places of the Fixed Stars by Professors Coffin and Hubbard, United States Navy.

In the volume of astronomical observations for 1848, the Institution first bears the name of UNITED STATES NAVAL OBSERVATORY in place of National. The Secretary of the Navy had thus ordered, because the Institution had always been under the control of the Navy Department, and was conducted by Navy officers; "its reputation is the property of the Navy."

During the year 1848, the east wing of the Observatory was extended 24 feet beyond its original dimensions planned by Lieutenant Gilliss, connecting the wing with the Superintendent's quarters erected in 1847. This furnished a suitable room for the storing and daily care of the chronometers, a duty closely maintained to the present time.

WIND AND CURRENT CHARTS.

A considerable portion of the volume issued by the Observatory for the first year, 1845, had been occupied by a report on the subject of the Wind and Current Charts, for the preparation of which authority had been given by the Navy Department, and which had thus early begun to occupy the attention of the Superintendent.

For each of the years 1846, 1847, and 1848 he reports that in connection with the preparation of these charts, "a large number of ships were engaged in connection with the Observatory, in making observations on all parts of the ocean upon winds, currents, the barometer, and air and water thermometer, and upon other phenomena calculated to improve navigation."

Upon the examination of the logs and other returns from these vessels, a large corps of lieutenants and passed midshipmen were employed; but often "almost the entire corps were ordered to sea at a moment's warning."

It would appear from the notices of the Institution, by the Secretaries of the Navy and the annual reports of the Superintendent of the Observatory during the years 1849 to 1861, that his chief interest in the Institution was centered in its fulfilling the character of a hydrographic office—in the preparation and publication of the Wind and Current Charts. His letters to the Navy Department to which Congress is referred in the annual reports of the Secretaries and the references to the Institution by the Secretaries themselves, are occupied almost exclusively with the progress and the value of the charts, "as part and parcel," as was said, "of the universal policy of civilized nations to accelerate transit from place to place to the utmost possible extent."

[1] James Major, commissioned professor of mathematics August 14, 1848.

In 1849, Hon. Mr. Preston reported that "the observations, calculations, and experiments at the Observatory, the preparation of maps and charts, and the regulating of chronometers have been zealously continued. * * * the demands constantly made upon the Institution for scientific information, charts, and sailing instructions evincing the increasing confidence in the Observatory."[1]

In the report of Secretary Graham of November 29, 1851, he says: "The Wind and Current Charts planned by Lieutenant Maury, are being extended to the Pacific and Indian Oceans. * * * "This work has materially shortened the passage along the highways by which our commerce passes into and through the southern hemisphere."

The volumes issued from the Observatory and Hydrographic Office on this subject, beginning with the Abstract Log of 1849, and followed by eight volumes or "editions" of Sailing Directions—the eighth edition being a large quarto of two volumes—bear witness to the ability, earnestness, and labor with which these publications were prepared. The force employed upon them was often changed and reduced by the demands for officers during the Mexican war, and, afterward, for other sea duty.

In regard to the astronomical work of the period referred to, and in reply to inquiries for annual volumes or publications to represent it, it is proper to say, further, that some of the professors, as well as the junior line-officers, were placed on duty upon the charts; that astronomical observations were fully kept up until the close of 1850, although those for that year were not finally reduced and published until 1859; and that the work of the equatorial was fully kept up during the whole period by Mr Ferguson,[2] and that of the mural circle from the year 1853 by Professor Yarnall.[3]

In the year 1858, Professor Yarnall, finding his results for the previous six years nearly ready for the press, decided, by leave of the Superintendent, to complete them by right-ascension observations with the transit instrument, and thus to put them in form for cataloguing. His catalogue will contain about 10,000 stars. Their positions have been derived from the observations made at this Observatory from the time of its establishment to 1871. The number of observations is from 80,000 to 90,000.

His work, begun August 26, 1858, and continued to the present date, results in the completion of two publications to form appendixes to the annual volume for 1871, now in press.

The results of Mr. Ferguson's observations with the equatorial for the period referred to are also nearly ready for the press. The published results of other officers —the observations with the meridian circle by Professor Hubbard and Lieutenant Maynard; those with the mural circle by Professor Coffin and Lieutenants Page and Steedman; and those with the transit instrument by Professors Keith, Beecher, and Hubbard, and Lieutenants Almy and Parker—have already been noted in the foot-note of page 34 of this memoir. Other observations for this period have not, however, been reduced or published.

Mr. Walker, whose achievements in the outset promised much for the Institution, within fourteen months from the date of his appointment, resigned to accept the direc-

[1] Report of Secretary Preston, December 1, 1849.

[2] Mr. Ferguson was successful in discovering for the Observatory the three asteroids Euphrosyne, Virginia, and Echo.

[3] M. Yarnall, appointed Professor of mathematics February 1, 1839; commissioned August 14, 1848; joined the Observatory in October, 1852.

tion of the longitude department of the Coast Survey; Professor Coffin was detached in 1852 to join the Naval Academy at Annapolis. With the exceptions of the equatorial, and mural circle observations, the zone observations named above, and the unpublished work of other observers during the latter part of the ten years, (1851–'61,) astronomical work unhappily ceased to be the definite object placed before the Institution. The Wind and Current Charts absorbed the attention of the Superintendent.

On the 26th of April, 1861, Commander Maury suddenly left the Observatory and the city to join the cause of the so-called Confederate States of the South.

RESUMPTION OF ASTRONOMICAL WORK.

Superintendency of Captain J. M. Gilliss, 1861 to 1865.

On the 22d of April, 1861—nearly twenty years after the founding of the Observatory—it was placed in charge of the officer by whose efforts chiefly that founding had been secured. His ideas of the true aims and work of the Institution remained unchanged from those expressed at the date of his report in 1845. He had then said that "he would have regarded his time as misspent to labor so earnestly only to establish a depot of charts and instruments; that his aim was to place an institution under the management of naval officers, where, in the practical pursuit of the highest known branch of science, they would compel an acknowledgment of abilities hitherto withheld from the service." Desires and purposes like this marked his brief superintendency, commencing April 22, 1861.

In the introduction to the first volume of observations issued under his charge—those for 1861, published promptly in 1862—he gave a detailed statement of the astronomical, magnetical, and meteorological observations which he found unprepared for the press from the circumstances which have been named in connection with the preparation of the Wind and Current Charts during the previous superintendency.

He also took immediate measures toward the reduction and publication of these observations, and for the regular and prompt issue from that date of annual volumes from the Observatory. Meteorological observations were to constitute a part of each future volume.

The Institution still retained as its full official name "The Naval Observatory and Hydrographical Office," and was under the Bureau of Ordnance and Hydrography, Captain A. A. Harwood, chief. It was still charged with the receipt, examination, and distribution of the books and charts to cruising-vessels; more than 20,000 sheets being sent out from the office during the year under the supervision of Lieutenant (now retired Commodore) W. B. Whiting and Professor A. G. Pendleton.[1]

Under the re-organization of the several Bureaus of the Navy Department, in accordance with the law approved August 31, 1862, the Observatory was transferred to the Bureau of Navigation, of which Commodore (now Rear-Admiral) C. H. Davis was in the same year made Chief.

The astronomical and meteorological observations made during the year 1862 were issued in 1863, as promptly as the Government press during those war-times could deliver them. In addition to a largely-increased number of observations, the

[1] Appointed Professor of mathematics February 19, 1838; commissioned August 14, 1848.

volume contained a discussion by Professor Newcomb[1] of the longitude of Washington as derived from moon culminations observed at the Royal Observatory, Greenwich, and the United States Naval Observatory, Washington, during the years 1846–'60, inclusive. The difference of longitude between the Observatories of Greenwich and Washington, as derived from a comparison of 279 corresponding culminations, was $5^h\ 8^m\ 11^s.6$.[2]

This volume also contained a paper on the aspects of comet II, 1862, with drawings by Professor Harkness[3] of the comet during the period of its greatest brilliancy, the observations of the comet with the equatorial having been made by Professor Asaph Hall[4] United States Navy. The volume has a plate illustrating the appearances of the planet Mars, near the opposition, in that year, as the planet was seen in the equatorial, September 6, 12 p. m., and September 30, 11 p. m.

The astronomical work presented for the year 1863, in addition to the usual routine observations with the several instruments, was an investigation of the solar parallax from observations on the planet Mars, made near the opposition, 1862, by Professor Hall and Mr. James Ferguson; and new elements of Nemausa by Professor Hall.

The aggregate result of astronomical observations made during the year with four instruments consisted of nearly eleven thousand observations, embracing those upon the sun, moon, the larger planets, eleven asteroids, two comets, and sixty-two double stars, sixteen occultations, and differential measurements of thirty-nine stars in the Pleiades group.

Requisition for a New Telescope.

The great defect of the Observatory, arising from the low optical capacity of the telescopes of its meridian instruments, was represented by the Superintendent as becoming each day more grievous. At the time of the founding of the Observatory only four asteroids were known, and 7 at opposition, - all of them were observable with the instruments then selected. Of the seventy-five minor planets added to the list between the years 1845 and 1863, three-fourths of them would be forever invisible with the telescopes of the Observatory, even under the most favorable circumstances; and as the number was constantly increasing, each one observed with the equatorial necessarily involved repeated observations with two other instruments to determine the places of comparison-stars. With its original equipment, three instruments, and three observers at two epochs, were indispensable for determining data which a single proper instrument would enable one assistant to determine more satisfactorily by a single observation. Of necessity, the burden of making the most reliable observations of all these bodies devolved upon the very limited number of establishments having meridian instruments of suitable capacities, and probably they had other marked lines of work which, in consequence thereof, were greatly interfered with. In fact, of the two known observatories having both means and men for the work, Greenwich was the only one that attempted to follow them regularly, and the task had become excessively onerous.

[1] Simon Newcomb, commissioned Professor of mathematics in the United States Navy, and ordered to the Observatory in September, 1861.

[2] The adopted longitude of the Observatory from Greenwich used in interpolating tabular positions of the moon and planets is $5^h\ 8^m\ 12^s.0$. See Washington Observations for 1869, p. X.

[3] Asaph Hall, commissioned Professor of mathematics May 2, 1863.

[4] William Harkness commissioned Professor of mathematics May 24, 1863.

To the mind of Captain Gilliss it was the imperative duty of the Washington Observatory to assume its portion of the observations and responsibility at the earliest practicable period.

On the representation of these facts to Admiral Davis, Chief of the Bureau of Navigation, authority was promptly and most cordially granted to obtain an instrument commensurate with the demands of astronomy and the character of the Observatory.

The Transit Circle was therefore contracted for early in the year 1863. Extreme care is shown through the details of this contract, and in the subsequent correspondence with the contractors, Pistor & Martens, of Berlin, that it should meet the highest expectations of the Observatory. The Superintendent repeatedly expresses his solicitude in respect to it, and more than once, in his correspondence with other astronomers, the hope that it would be adjusted and at work by the commencement of the year 1865.

The results of the astronomical work during the years 1863 and 1864 were collated and prepared for the press under Captain Gilliss's supervision, but through the pressure on the Government office for military printing during those years, they were not published before his death.

Among the latest of his official letters are those referring to three important objects which at that time claimed the attention of the Observatory. These were the securing of the transit instrument already referred to, the bringing forward the unpublished observations made during the years preceding his own superintendency, and the success of the simultaneous observations instituted by him for determining the solar parallax.

He was not, however, to see the final success of any one of these aims. His lamented death on the 9th February, 1865, was without any previous illness or indisposition. It has been noted as a strange coincidence of circumstances that the last morning of his life witnessed an announcement of results deduced at this Observatory which had fulfilled his long-deferred hope of determining the solar parallax by simultaneous observations in Chile and in the United States. This announcement would have been peculiarly gratifying to him, because these results were from the joint activity of the two Observatories, founded through his own exertions, five thousand miles apart.[1]

A reference to these new observations, and the results to be deduced, is to be found in the introductions to the volumes of observations for 1862 and 1863; and the full original plan of observations for this object, in Vol. III of United States Naval Astronomical Observations to the southern hemisphere.

Just one week after the death of the Superintendent died, also, and as suddenly, Professor A. G. Pendleton, who had been many years on duty in the United States Coast Survey before his useful connection with the Observatory.

Superintendency of Rear-Admiral C. H. Davis, 1865 to 1867.

On the 28th of April, 1865, the Observatory was placed in charge of Rear-Admiral C. H. Davis, formerly Superintendent of the American Ephemeris and Nautical

[1] Annals of American Association for 1866, p. 6.

Almanac, and, at the date named, Chief of the Bureau of Navigation in the Navy Department.

Admiral Davis reported in October of this year the arrival, mounting, and preparation of the great Transit circle contracted for by Captain Gilliss.

"The employment," said the Superintendent, "of this instrument, in the Naval Observatory, constitutes a new era in its progress, and restores it to the rank of a first-class institution. The old instruments of this establishment were fully, both in the size and the style of their construction, up to the standard of the day in which they were ordered. But new and important advances have since been achieved in the art of making astronomical instruments, in size as well as in precision; and we find ourselves now in possession of a circle with which we can measure right ascensions and polar distances at the same moment and with equal exactness."

A precise description of this instrument, accompanied by an elaborate inquiry into the errors of division of its circles, was prepared by Professor Simon Newcomb, United States Navy. The circle was placed in position October 28, 1865, in the then west wing of the Observatory. The cylindrical registering-apparatus in this room was put in connection with the Kessels clock and a regular course of observations with the instrument begun January 1, 1866.

During the years 1865 and 1866, the Superintendent published the volumes containing the astronomical and meteorological observations made during the last two years of Captain Gilliss's superintendency, 1863 and 1864; accrediting their collation and supervision in each case in a note on the reverse of the title-page.

In addition to the observations with the several instruments, reported in the volume for 1864, an appendix by Professor Newcomb, discussed the latitude and longitude of the Observatory, and the declinations of certain circumpolar stars.

Discussion of the Meteorological Observations, 1842 to 1867.

With the astronomical work of the year 1866, Professor J. R. Eastman[1] presented a full discussion of the meteorological observations made at the Observatory from June 30, 1842, to January 1, 1867. The investigation of these observations to determine their true character was one of the objects proposed by Commander Gilliss when he took charge of the Institution, in 1861. The investigation proposed to ascertain, if possible, the adopted methods of observation from 1842 to 1867; to learn how far they were made in accordance with the adopted plan; and to determine their value. The discussion, published by Admiral Davis in the volume for 1866, answers these points as favorably as fidelity to the investigation would permit. It forms the Appendix of that volume.

The Institution still retaining the character of a hydrographic office, there was required of the Superintendent, this year, a report on interoceanic canals and railroads under the resolution of the United States Senate of March 19, 1866, which follows:

"*Resolved*, That the Secretary of the Navy furnish, through a report of the Superintendent of the Naval Observatory, the summit-levels and distances by survey of the

[1] J. R. Eastman, commissioned Professor of Mathematics February 17, 1865.

various proposed lines for interoceanic canals and railroads between the waters of the Atlantic and Pacific Oceans, as also their relative merits as practicable lines for the construction of a ship-canal, and especially as relates to Honduras, Tehuantepec, Nicaragua, Panama, and Atrato lines." * * *

In obedience to this call, the Superintendent presented to the Secretary of the Navy, July 11, 1866, a report on the various proposed lines on the Isthmus and their special relations to the practicability of a ship-canal. The report was accompanied by fourteen illustrative maps, profiles, and surveys; of the first and of the second edition, ordered in 1867, eight thousand copies were printed by the Senate, nearly one thousand being distributed by the Observatory. Prof. J. E. Nourse assisted in preparing this Report.

In consequence of the organization of the United States Hydrographic Office under the act of Congress of June 21, 1866, the charts and nautical instruments which had been in the charge of the Observatory until this year, were removed to the Hydrographic Office, New York avenue and Eighteenth street, Washington; chronometers only being retained.

On the 8th of May, 1867, Rear-Admiral Davis was detached from the Observatory to take command of the South Atlantic Squadron.

SUPERINTENDENCY OF REAR-ADMIRAL B. F. SANDS, COMMENCING MAY 8, 1867.

The Observatory was placed under the charge of the present Superintendent, Rear-Admiral Benjamin F. Sands, United States Navy, by order of the Navy Department, May 8, 1867. During this year the work of the Institution was chiefly as follows:

The *Equatorial*, under Mr. James Ferguson, assisted by Professor J. R. Eastman, was chiefly employed in the observations of the more recently discovered asteroids, upon the companion of Sirius, and on stars about the variable star in Corona Borealis.

The *Transit Circle*, under Professors Newcomb and Hall, assisted by Mr. C. A. Thirion, Mr. Joseph A. Rogers, and Mr. C. Abbe, Aids, continued the work of a more accurate determination of the positions of the stars in the American Ephemeris, and of determining the positions of 350 stars required by the Coast Survey in determining the latitudes of its stations. The number of celestial observations for the year reached 5,000, the determinations of the Coast Survey stars requiring more than 1,000 observations.

The *Mural Circle* and the *Transit Instrument* were employed under Professor M. Yarnall, assisted by Mr. M. H. Doolittle, Aid, in observations necessary for the General Catalogue of Stars, now in press as an appendix to the volume for 1871.

The volume of observations for 1865, made under the superintendency of Admiral Davis, was published during this year. It contained two appendixes, the Description of the Transit Circle, with an Investigation of its Constants: and an Investigation of the Distance of the Sun.

The meteorological observations, under Professor J. R. Eastman, were fully kept up: the desirableness of securing yet more valuable results than were found possible

with the present instruments prompted special recommendations by the Superintendent, and estimates for the purchase of the latest and most improved meteorological apparatus and the construction of a tower for the observations.

The *Chronometer-Room*, in charge of Commander A. W. Johnson, contained, at the date of the Superintendent's report, October 10, 1867, one hundred and one chronometers running on trial. By collating the history of each chronometer from the date of its manufacture and purchase in connection with its time of trial at the Observatory—a practice introduced during this year—chronometers to the number of eighty-eight were condemned as unreliable, and, by authority of the Bureau, withdrawn from service.

The *Library* received a handsome donation of scientific works from the widow of the former Superintendent, Captain James Gilliss, being a portion of the collection left by him.

During the year 1868, in reporting the progress of the largely increased astronomical work of the Observatory, the Superintendent took occasion to represent the deficiency of the Institution in the want of a telescope at all comparable with many owned by colleges, observatories, and even by scientific individuals throughout the country. He recommended the employment of Mr. Alvan Clark, of Cambridgeport, Massachusetts, to construct for the Observatory the largest refractor in the world.

The full routine work with the Equatorial, Transit Circle, and Mural Circle was maintained during the year.

Besides the volume of Astronomical and Meteorological Observations for 1860, issued in April, 1863, there were distributed the following publications, viz: Report on the Meteoric Shower of November 14, 1867, by Professors Newcomb, Harkness, and Eastman, and a Discussion of the Cyclone in the West Indies of October 29 and 30, 1867 by Prof. Eastman.

In the report of the Superintendent for the year 1869, the wants of the Observatory and the opportunity of securing the refractor from Mr. Clark were again laid before the Navy Department and an appropriation of $50,000 for this instrument was submitted in the estimates.

The erection of a new observing-room for the Transit Circle was completed during the summer of this year. The construction of the room is peculiar, the sides being formed of tinned iron 0.015 of an inch thick, shaded from the rays of the sun by light wooden louver-work, a construction adopted in order to secure equality of temperature.[1] This observing-room forms an extension of the west wing, with the dimensions of 40 feet from north to south and 28 feet 3 inches from east to west. The mounting of the circle in this observing-room was completed February 2, 1870, and observations commenced with it by Professor Harkness in charge, assisted by Professor J. R. Eastman and Assistant Observers Edgar Frisby and Ormond Stone.

[1] The observing-room and the transit circle are described by the Professor in charge in the volume of Observations for 1870.

The erection of this new room gave opportunity for a removal of the LIBRARY from the south wing to the room previously occupied by the Transit circle—a removal made necessary by the increase of the library, which, at the date of this memoir, embraces more than 5,000 bound volumes.

By the facilities offered by the Western Union Telegraph Company, the *longitudes* of three points were determined during the years 1868 and 1869, through the use of the telegraphic apparatus and connections of the Observatory.[1] These were:

1. Of a station in the arsenal grounds at Havana, Cuba, for determining the longitude of which, at the request of the Spanish government, time-signals were exchanged on four nights of September, 1868, between the Observatory, and Lieutenant C. Pujazon of the Spanish navy. These signals placed the station

$$0^h\ 21^m\ 12^s.58 \pm 0^s.035$$

west of the center of the Observatory dome.[2]

2. Of a station taken at Des Moines, Iowa, by the Observatory party sent to observe the solar eclipse of August 7, 1869. These signals placed the station at Des Moines

$$1^h\ 6^m\ 16^s.05 \pm 0^s.05$$

west of the center of the dome.

3. Of a station taken by a party from the United States Coast Survey at Bristol, Tennessee, whose station was determined

$$0^h\ 20^m\ 32^s.74$$

west of the center of the dome.

Time-signals were also exchanged April 7, 1869, with an observing-party of the United States Coast Survey stationed at Staunton, Virginia.

The astronomical event during the year 1869, exciting general and lively interest, and productive of important results to astronomical science, was

THE TOTAL SOLAR ECLIPSE OF AUGUST 7TH.

This was closely observed by the parties from the Observatory: by Professor Asaph Hall, U. S. N., with Mr. J. A. Rogers, of the U. S. Hydrographic Office, at a station in Plover Bay, Alaska; by Professors Newcomb, Harkness, and Eastman, at the court-house of Des Moines, Iowa; and by Mr. F. W. Bardwell, Aid, at Bristol, Tennessee. Assistant Surgeon, Brevet Major Edward Curtis, U. S. A. accompanied the Des Moines party.

The reports and discussions of this eclipse by the Naval observing-parties—together with those by Dr. Curtis, Mr. J. Homer Lane of Washington City, and Mr. W. S. Gilman, jr. of New York, and Brevet Brigadier-General A. J. Myer, U. S. A., made at other stations—form a quarto volume of 217 pages, with twelve illustrations. Of this volume, besides the usual number furnished within the annual volume of the

[1] The telegraphic apparatus and connections of the Observatory are in charge of Professor Harkness, assisted by Mr. W. F. Gardner.

[2] The report on this difference of longitude between Washington and Havana forms Appendix I of the volume of Washington observations for the year 1867, published in 1870.

Observatory, three thousand five hundred copies were printed by joint resolution of Congress.[1]

The special astronomical work of the Observatory for the year 1870, in addition to the full progress of the routine observations, was the conclusion of the observations by Professor Hall of the stars in Præsepe, with the publication of a catalogue of 151 stars in that group; the commencement of the revision of the tables of the moon by Professor Newcomb; and the observations in Europe of

The Total Solar Eclipse of December 22, 1870.

The Superintendent of the Observatory, believing that the experience of its officers in their observations of the eclipse of August 7, 1869, should be availed of for the further elucidation of the subjects involved in such phenomena, addressed the Navy Department upon the subject of their employment in Europe in observing the eclipse of 1870, by a special letter, March 4th of that year. The Department promptly detailed the Professors who had been the observers of the previous year.

Professor Newcomb, through the courtesy of Sir George Biddell Airy, the Astronomer-Royal, and of Sir James Anderson, President of the Anglo-Mediterranean Telegraph Company, made full arrangements to correct the stations of the American observers by cable for difference of time with the Greenwich Observatory. This was accomplished between Sicily, Malta, and Gibraltar, failing with Greenwich in consequence of a break in the cable between that place and Lisbon. Professor Newcomb's observations of the eclipse were made at a point known as Buena Vista, between the town of Gibraltar and Europa Point. The observations of Professors Hall, Harkness, and Eastman were made at Syracuse, Sicily. Captain Tupman, R. M. A., volunteered to assist Professor Harkness in his observations, and a report of his own results, with his drawing of the eclipse as seen at Syracuse with a 11-inch telescope, is included in the Observatory report.

Unfavorable weather prevented the most successful observations of this eclipse. Those which were secured tend mainly to corroborate the observations of the eclipse of the previous year. The existence in the corona of a bright line, whose wave-length is 531.6 millionths of a millimeter, was verified, and the line found in *all parts* of the corona. Two other bright lines of less refrangibility were also found in one part of the corona. The radial polarization of the light of the corona was definitely observed.

The following differences of longitude were determined by cable by Professors Newcomb, Hall, and Harkness, of the Eclipse party:

Spencer's monument, Malta, east of flag-staff, at landing-place, Gibraltar, $1^h\ 19^m\ 27^s.52 \pm 0^s.15$. Light-house on Maniace Castle, Syracuse, east of Spencer's monument, Malta, $0^h\ 3^m\ 12^s.19 \pm 0^s.16$.

[1] The reports embraced, besides the observations named above made with astronomical instruments, returns from more than thirty parties of amateur observers without telescopes, who noted the beginning and the ending of the totality of the eclipse, in accordance with a circular of instructions previously furnished from the United States Naval Observatory. These returns were made by parties who accepted the invitation of the Observatory to co-operate in this way in the observations. The observers resided mostly near the northern or the southern limits of totality in the States of Iowa, Illinois, Indiana, Kentucky, and Missouri.

A very large edition of the report of this eclipse has been called for and mostly distributed. It forms Appendix I, Washington Observations for 1869.

During the year 1871, the work of the Transit Circle was for a time necessarily suspended by the absence of Professors Harkness and Eastman, on duty in Europe, and the nearly fatal illness of the former which delayed his return; and by the re-grinding of the object-glass.

The observations with the Equatorial were uninterrupted. They were made specially on 27 of the minor planets; upon two new comets, discovered during this year by Winnecke and Tempel in Europe; on the two comets, Encke's and Tuttle's, whose periodical returns occurred during the year; and upon moon occultations. The observations on Encke's comet by Professors Hall and Harkness, form Appendix II, of the annual volume for 1870, just issuing from the press. The elements of the orbit of Comet I, 1871, were also computed.

The Transit instrument and Mural circle were employed by Professor Yarnall chiefly on observations necessary for filling in star-places in the General Star Catalogue which is to be found in the volume for 1870.

At the request of the Chief of the U. S. Corps of Engineers, the Observatory aided in determining the differences of longitude between the Observatory and Detroit, and the Observatory and Carlin and Austin, Nevada. In this work the Observatory co-operated with General C. B. Comstock, Superintendent U. S. Lake Survey, and Lieutenant G. M. Wheeler, commanding the Exploring Expedition to Nevada and Arizona.

The revision of the tables of the moon, for which an appropriation of $2,000[1] was made by Congress in the previous year, was materially advanced by the facilities courteously afforded Professor Newcomb, the officer charged with the work, during his visit to the principal observatories and libraries of Europe. The records of observations of eclipses and occultations of the moon which were discovered on this visit, extended as far back as the year 1680—seventy years before the epoch at which it had been generally supposed that our accurate knowledge of the moon's motion begins.

In the work of the Observatory reported October 1, 1872, the *Equatorial* was employed, by the observers Professor Hall and Assistant Professor A. N. Skinner, chiefly in observations on the numerous newly-discovered asteroids. A series of measurements of the double star Sirius was made and furnished, through the Superintendent, to the Astronomische Nachrichten in Altona, Germany.

The *Transit Circle* was employed on the sun, moon, and planets; and on a list of miscellaneous stars whose places were required for the better determination of the latitude of the eclipse-stations of August, 1869, at Des Moines, Iowa, for the reduction of observations to be used in the revision of the theory of the moon, and for reduction of observations made by the equatorial. A new chronograph was received, made by Messrs. Clark, of Cambridgeport, Massachusetts, from designs by Professor Harkness.

With the *Mural Circle*, Professor Yarnall observed a series of stars taken alternately above and below the pole and a number of stars whose declinations were wanted to complete the places of some already observed in right ascension. In the computations on the star catalogue aid was rendered by Professor H. H. Lockwood, U. S. N.

[1] Under this appropriation, three computers, Messrs. Parker, Hedrick, and Brown, have been employed, rendering valuable assistance.

The first part of the *theory* and *tables of the moon*, under revision by Professor Newcomb, comprising the calculation by a new method of the action of the planets on the moon's motion, was nearly completed. In the preparation of the second part, comprising the comparison of Hansen's tables with observations before the year 1750, very important help in the re-determination of the proper motions of the principal stars was rendered by the eminent astronomer Dr. Auwers, of Berlin, who communicated his re-reductions of Bradley's observations from 1750 to 1860.

In July and August, 1872, the Observatory co-operated with the U. S. Coast Survey by exchanging longitude signals with the Coast Survey parties at Cambridge, Massachusetts, and St. Pierre, near Newfoundland; Professor Harkness exchanging the signals from the Observatory. At the same time, signals were exchanged by the U. S. Coast Survey between Saint Pierre, and Brest, France, and between the latter station and Paris and Greenwich, the object being to obtain another determination of the difference of longitude between the fundamental points in Europe and America.

Successful observations of the meteoric showers both of August and of November of this year were prevented by unfortunate weather.

The usual daily *Meteorological Observations* were made at the regular intervals of

0^h, 3^h, 6^h, 7^h, and 9^h a. m., and 0^h, 3^h, 6^h, and 9^h p. m.

The Chronometer-room during this year received eighty chronometers. At the date of October 1st, ninety-seven were on hand ready for issue to sea-going vessels.[1]

From this room mean time is now sent daily, at 7 a. m., 12 m., and 6 p. m., to the police-stations of this city, and at 12 m. to the Western Union telegraph-office, for communication to the offices of the company's lines throughout the United States.[2]

The Great Equatorial now Constructing.

In the act making appropriations for the naval service for the year ending June 30, 1871, Congress authorized the Superintendent of the Observatory to contract for the construction of a refracting telescope of the largest size, of American manufacture, at a cost not exceeding $50,000, recommendations for which had been made by him in the years 1870 and 1871. They further authorized, by the naval appropriation bill for 1872, the erection of a tower and dome for this instrument.

By direction of the Superintendent, the contract for the telescope was negotiated in August, 1870, by Professor Newcomb, between Messrs. Alvan Clark & Sons, of Cambridgeport, Massachusetts, and the Observatory. By this contract, Messrs. Clark are to construct a refracting telescope, of good definition and of 26 inches clear aperture, mounted equatorially on the German plan, with all the means necessary to secure easy motion, proper balance in all positions, and the safety of its object-glass; with divided circles, to be each read by two microscopes—right-ascension circle to seconds, declination-circle to tenths of a minute of an arc;—with a driving-clock, and with the usual

[1] Under the sanction of the Navy Department, Chronometers are also issued from the Observatory to the various surveying and scientific Expeditions of the Government.

[2] A time-ball is dropped on the roof of the Observatory daily at noon. The clocks at the Navy Department and the U. S. Signal-Office of the War Department are controlled electrically by the Observatory clock, the expectation being to include in the circuit the several Department buildings.

number of eye-pieces and ring-micrometers, a filar micrometer, an Airy double-image micrometer, a mica-scale micrometer, and a spectroscope. Messrs. Clark engage to complete and mount this telescope within four years from the date of the contract.

The object-glass, made in the rough by Chance & Co., of Birmingham, England, was received by Messrs. Clark in December, 1871. It was ground, polished, and completed by them in November, 1872. The glass entirely satisfies the expectations of the Observatory. The work on the tower and the dome has been commenced.

Co-operation of the Observatory in the Observations of the Transit of Venus, December 8, 1874.

Preparatory measures for this object were early taken by the Observatory. At the request of the Superintendent, Congress appropriated, in 1871, the sum of $2,000 for experiments to be made on the best forms of instruments to be used in these observations.

By section 2 of the naval bill making this appropriation, a Commission in reference to this Transit was made to consist of the Superintendent of the Observatory, the President of the National Academy of Sciences, the Superintendent of the United States Coast Survey, and two Professors of Mathematics of the Observatory. Prof. Simon Newcomb, U. S. N., and Prof. William Harkness, U. S. N., were detailed as members of the Commission.

In March, 1872, the Navy Department was addressed by the Superintendent, on the advisability of making national provision for the observation of the Transit, the expedition for which would also render important service in determining the position of points in the Pacific Ocean.

The estimate of the Commission of $150,000 (to be expended in three annual installments) was submitted in this letter of the Superintendent, endorsed by the Secretary of the Navy, Hon. G. M. Robeson, and responded to by Congress in the grant of the first installment of $50,000 for the purchase of instruments, June 10, 1872.[1]

This cordial response in Congress was secured by the support of the Senate Committee on Education, an able report from which was presented by the Hon. Mr. Sawyer; and by the influence in the House of Representatives of the chairman of the Committee of Appropriations, Hon. Mr. Garfield, with that of other Representatives.

Among those who memorialized Congress for this object were the Connecticut Academy of Sciences, the California Academy, the American Philosophical Society of Philadelphia, the Chamber of Commerce of San Francisco, and the University of California.

Under the appropriation already made, the Commission have contracted for most of the necessary instruments, and are carrying forward the previously-required experimental work for observing this rare and most important event.

They have issued the first two papers of a series upon this subject:

No. I, comprising a Correspondence with Mr. L. M. Rutherfurd, of New York, and a paper on the Application of Photography, by Professor Newcomb:—

[1] While these pages have been in press, Congress has appropriated the remaining $100,000; March 2, 1873.

No. II, —— Charts and Tables for facilitating Predictions of the several Phases of the Transit; prepared by Mr. G. W. Hill, Assistant in the Nautical Almanac Office, under the direction of Professor J. H. C. Coffin, Superintendent of the Almanac.

In reply to inquiries in regard to the plans of the Commission, Professor Newcomb, as their secretary, has replied in substance: That the principal reliance during the observations of the transit will be on photography; and that arrangements are being made for equipping eight photographic stations—four in the Northern Hemisphere in China, Japan, and probably in the adjacent islands; and four in the Southern Hemisphere in New Zealand, Chatham Island, Tasmania, and probably Kerguelen Island. Each station will be provided with an astronomer, an assistant astronomer, and photographic assistants.

The record of the work of the Observatory offered in the preceding Memoir closes with this reference to the transit of Venus and to the natural relation to it held by the Institution. It purposes to fulfill that share in the observations and in the results to be deduced from them, which the astronomical world justly expects of it. The daily increasing interest in this phenomenon and its astronomical importance may be yet more appreciated by the general reader by attention to the following recent statement of a distinguished writer on astronomy, Professor R. Grant, Director of the Royal Observatory, Edinburgh:

"The approaching transits of Venus in 1874 and 1882 are looked forward to by astronomers with intense interest. Steps have already been taken by the principal nations of Europe to observe the transit of 1874 with the aid of all the appliances of modern science. The transit of 1882 will be eminently *favorable for observation in America.* Between those two important phenomena there will occur one of those oppositions of the planet Mars which are peculiarly favorable for the same purpose. We have thus three phenomena—the transit of Venus in 1874, the opposition of Mars in 1877, and the transit of Venus in 1882—all favorable for obtaining a fresh determination of the value of the solar parallax; and it cannot be doubted that the various efforts which they will call forth on the part of astronomers will lead to a value of that important element still more trustworthy than any yet arrived at."

In CONCLUDING this Memoir, it is proper to say as regards the future of the U. S. Naval Observatory, that the position now accorded to it by the free tributes of scientific men in the Old World, as well as at home, is not without honor to our country; and this notwithstanding the comparatively recent founding of the Institution and the as yet limited appropriations sustaining it. It may, therefore, justly claim a yet more generous support; and the pledge may be safely made that if thus supported and efficiently directed, it will make returns yet more gratifying to national pride, and advancing the highest aims of scientific research. The increasing work of the Institution, especially during the last four years, is fairly presented in the extent and character of its publications.[1] To these only a general reference has been found practicable through-

[1] The demand for these has nearly exhausted the supply of all publications which precede the volume for 1870.

out the preceding sketch. The Table closing it will show the issue of the now completed work of some previous years—until lately unreduced—as well as the full labors of current years of observation.

Independently, however, of all claims derived from its own records, the unprecedented advance of science in our day demands the best national provision for the *personnel* and equipment of the Observatory, and for its efficient direction to the highest astronomical aims.

The extent of the field of investigation which is opening, its *practical usefulness*, and the claim that *National Institutions* shall enter upon what cannot otherwise be secured, have been lately urged on more than one occasion before the first of astronomical societies, the Royal Astronomical Society of London.

The following is from a paper read by Lieutenant-Colonel Strange, F. R. S., at the session of the Society of April 12, 1872:

"I content myself with stating my opinion that permanent national provision for the cultivation of the Physics of astronomy is urgently needed. If the study of the sun only were in question, that alone would, I think, justify such a measure; for there can hardly be a doubt that almost every natural phenomenon connected with *climate* can be distinctly traced to the Sun as the great dominating force, and the inference is unavoidable that the changes, and, what we now call, the uncertainties, of climate, are connected with the constant fluctuations which we know to be perpetually occurring in the Sun itself. The bearing of climatic changes on a vast array of problems connected with *navigation*, *agriculture*, and *health* need but be mentioned to show the importance of seeking in the Sun, where they doubtless reside, for the causes that govern these changes. It is, indeed, my conviction, that of all the fields now opened for scientific cultivation, there is not one which, quite apart from its transcendent philosophical interest, promises results of such high utilitarian value as the exhaustive, systematic study of the Sun."

What further share the Naval Observatory shall secure in such investigations, or in others of like character within special fields of research, or in the general advancement of science, and what shall be its future records of success—must remain with the support extended by the Government and the fidelity of those who are entrusted with its administration. It is certainly a source of congratulation to the Government and especially to the Navy, that this Institution, nurtured and fostered by the Navy Department through successive changes of administration in the Heads of that Department and under the zeal and labor of Naval Officers, has advanced from so humble an origin to the position which it has secured.

SUPERINTENDENTS OF THE OBSERVATORY.

Commander M. F. Maury, from October 1, 1844, to April 20, 1861.
Captain J. M. Gilliss, from April 22, 1861, to February 9, 1865.
Rear-Admiral C. H. Davis, from April 28, 1865, to May 8, 1867.
Rear-Admiral B. F. Sands, from May 8, 1867.

Officers in Charge of Instruments Since 1861.

The Equatorial.—Assistant Astronomer J. Ferguson, Professors Newcomb, Hall.
The Prime Vertical.—Professors Hubbard, Newcomb.
The Transit Instrument.—Professor Yarnall.
The Mural Circle.—Professors Hubbard, Newcomb, Yarnall.
The Transit Circle.—Professors Newcomb, Hall, Harkness.
The Meteorological Instruments.—Professor J. R. Eastman.

The Chronometers and Nautical Instruments.—Very frequent changes have occurred in the orders of the officers of the line, on duty at the Observatory in charge of the naval instruments and the charts.

After the transfer of the charts and other naval instruments at the date of the organization of the Hydrographic Office, 1866, Commander A. W. Johnson was in charge of the *chronometers*. He was succeeded by Commander W. N. Jeffers, and Commander Jonathan Young. At the present date, Commander James H. Gillis is in charge.

PUBLICATIONS OF THE OBSERVATORY.

I.—Volumes of Observations.

Astronomical Observations for	the year	1845	published in	1846
Do.	do.	1846	do.	1851
Do.	do.	1847	do.	1853
Do.	do.	1848	do.	1856
Do.	do.	1849–1850	do.	1859
Do.	do.	1851–1852	do.	1867
Astronomical and Meteorological Observations for		1861	published in	1862
Do.	do.	1862	do.	1863
Do.	do.	1863	do.	1865
Do.	do.	1864	do.	1866
Do.	do.	1865	do.	1867
Do.	do.	1866	do.	1868
Do.	do.	1867	do.	1870
Do.	do.	1868	do.	1871
Do.	do.	1869	do.	1872
Do.	do.	1870	do.	1873
Do.	do.	1871	in press.	

II.—SPECIAL OBSERVATIONS AND REPORTS.

Observation or Report.	Author.	Appendix to volume for the year—
Superintendency of Commander Maury.		
A.—Observations on sun spots	Rev. B. Sestini, S. J	1847
B.—Observations on the Mississippi River, at Memphis	Passed Midshipman R. A. Marr	
C.—Tables for facilitating reduction of apparent places of fixed stars to their mean places.	Professors J. H. C. Coffin, and J. S. Hubbard.	
[Zones of stars observed at the National Observatory in 1846, reduced by Assistant Astronomer James Ferguson, published in 1860.]	Lieutenant L. Maynard, Professor J. S. Hubbard.	
Superintendency of Captain Gilliss.		
Longitude of U. S. Naval Observatory from moon culminations	Professor S. Newcomb	1862
A.—Solar parallax from observations on the planet Mars, made near the opposition, 1862, with the equatorial.	Professor A. Hall	1863
A.—Solar parallax from observations on the planet Mars, made near the opposition, 1862, with the meridian instrument.	Assistant Astronomer J. Ferguson	
B.—Orbit of Nemausa	Professor A. Hall	
Investigation of the latitude and longitude of the Observatory and of the declination of certain circumpolar stars.	Professor S. Newcomb	1864
Superintendency of Rear-Admiral Davis.		
Description of the Transit Circle	Professor S. Newcomb	1865
Investigation of the distance of the sun		
Discussion of the meteorological observations from 1842 to 1867	Professor J. R. Eastman	1866
Report on interoceanic canals and railroads	Rear-Admiral C. H. Davis	
Report on November meteors of 1866		
Superintendency of Rear-Admiral Sands.		
I.—Report on the difference of longitude between Washington and Havana.	Professor W. Harkness	1867
II.—Reports on the total solar eclipse in the United States, August 7, 1869.	Professors S. Newcomb, A. Hall, W. Harkness, J. R. Eastman and others.	
III.—Positions of fundamental stars deduced from Washington observations 1862-'67.	Professor S. Newcomb	
IV.—Catalogue of 151 stars in Præsepe	Professor A. Hall	
Catalogue of stars observed by the United States Astronomical Expedition to the Southern Hemisphere, 1850-'52.	Lieutenant James M. Gilliss, Superintendent; Lieutenant A. McRae, Master S. Ledyard Phelps, and Mr. E. R. Smith, Assistants.	1868
I.—Reports on total solar eclipse in Europe of December 22, 1870.	Professors Newcomb, Hall, Harkness, Eastman.	1869
II.—Zones of stars observed with the Mural Circle in the years 1846, 1847, 1848, and 1849.	Professor J. H. C. Coffin, Lieutenant T. J. Page, Lieutenant C. Steedman.	
I.—Report on the difference of longitude between Washington and St. Louis.	Professor W. Harkness	1870
II.—Reports on observations of Encke's Comet, during its return in 1871.	Professors Hall and Harkness	
III.—Right ascensions of the equatorial fundamental stars and corrections necessary for reduction of right ascensions of different catalogues to a mean homogeneous system.	Professor S. Newcomb	
IV.—Zones of stars observed at the U. S. Naval Observatory, with the Meridian Transit Instrument, in years 1846, 1847, 1848, and 1849.	Lieutenant J. J. Almy, Lieutenant W. A. Parker, Professors R. Keith, Mark H. Beecher, J. S. Hubbard.	
Report on November meteors of 1867	Professors Newcomb, Harkness, Eastman.	
Discussion of West India Cyclone of October 29 and 30, 1867	Professor J. R. Eastman	
Report on November meteors of 1868		
In Press.		
I.—A list of mean places of stars observed at the U. S. Naval Observatory in the years 1858, 1859, 1860, for right ascensions, and 1853, 1854, 1855, 1856, 1857 and 1858, for declinations.	Professor M. Yarnall	1871
II.—Catalogue of stars observed at the U. S. Naval Observatory in the years 1845 to 1871, inclusive, reduced to the mean epoch 1860.0.	Professor M. Yarnall	
III.—Zones of stars observed with the Meridian Circle in the years 1847, 1848, 1849.	Professors Hubbard and Major; Lieutenant Muse.	
IV.—Memoir of the founding and progress of the U. S. Naval Observatory.	Professor J. E. Nourse	